VOL. 5 NO. 21
November 15, 1980

Energy Research Abstracts

ABSTRACTS 33171-34460

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications are regularly issued which are comprehensive in their coverage of certain energy fields. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

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Vol. 5, No. 21
ISSN: 0160-3604
CODEN: ERABDZ
November 15, 1980

ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

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•ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

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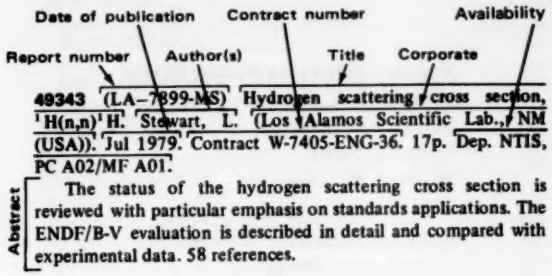
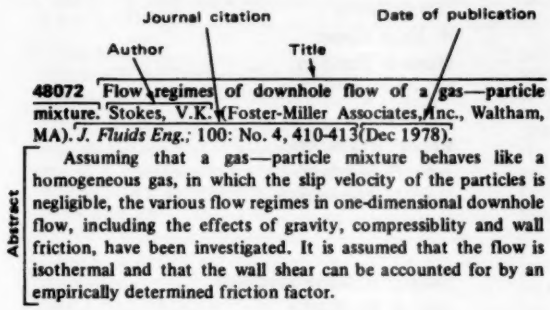

Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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CONTENTS

Category	Page
COAL AND COAL PRODUCTS	3667
PROCESSING	3667
DESULFURIZATION AND PURIFICATION	3668
HYDROGENATION	3668
GASIFICATION	3668
LIQUEFACTION	3670
PYROLYSIS AND CRACKING	3672
BY-PRODUCTS	3673
PROPERTIES	3673
WASTE MANAGEMENT	3674
ENVIRONMENTAL ASPECTS	3674
MINING	3675
TRANSPORT AND HANDLING	3676
COMBUSTION	3676
MARKETING AND ECONOMICS	3677
HEALTH AND SAFETY	3677
REGULATIONS	3677
PETROLEUM	3677
GEOLOGY AND EXPLORATION	3677
DRILLING AND PRODUCTION	3677
PROCESSING	3678
MARKETING AND ECONOMICS	3679
ENVIRONMENTAL ASPECTS	3680
POLICY, LEGISLATION, AND REGULATION	3680
TRANSPORT, PIPELINES, AND HANDLING	3680
PROPERTIES	3680
STORAGE	3681
NATURAL GAS	3681
RESERVES	3681
DRILLING, PRODUCTION, AND PROCESSING	3681
MARKETING AND ECONOMICS	3681
ENVIRONMENTAL EFFECTS	3681
ARTIFICIAL STIMULATION, PLOWSHARE, ETC.	3681
POLICY, LEGISLATION, AND REGULATION	3682
OIL SHALES AND TAR SANDS	3682
SITE GEOLOGY AND HYDROLOGY	3682
SITE GEOLOGY	3682
OIL PRODUCTION, RECOVERY, AND REFINING	3682
IN SITU METHODS, TRUE AND MODIFIED	3682
REFINING	3683
PURIFICATION	3683
PROPERTIES AND COMPOSITION	3683
WASTE RESEARCH AND MANAGEMENT	3683
ENVIROMENTAL ASPECTS	3684
NUCLEAR FUELS	3684
NUCLEAR FUELS	3684
RESERVES	3684
EXPLORATION	3684
FEED PROCESSING	3684
ENRICHMENT	3684
CENTRIFUGATION	3685
FUELS PRODUCTION AND PROPERTIES	3685
TRANSPORT AND STORAGE	3685
MARKETING AND ECONOMICS	3685
WASTE MANAGEMENT	3685
WASTE PROCESSING	3686
WASTE DISPOSAL AND STORAGE	3687
ENVIRONMENTAL ASPECTS	3689
HEALTH AND SAFETY	3689
REGULATIONS	3689
ACCOUNTABILITY AND SAFEGUARDS	3689
FUSION FUELS	3690
PROCESSING	3690
FABRICATION AND TESTING	3690
PROPERTIES	3690
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	3690
PHYSICAL ISOTOPE SEPARATION	3690
RADIATION SOURCES	3690
OTHER INDUSTRIAL USES	3690
ISOTOPIC POWER SUPPLIES	3690
HYDROGEN	3690
PRODUCTION	3690
ELECTROLYSIS	3691
THERMOCHEMICAL PROCESSES	3691
STORAGE	3691
CHEMISORPTION	3691
TRANSPORT	3691
INDUSTRIAL AND COMMERCIAL USE	3691
OTHER SYNTHETIC AND NATURAL FUELS	3692
HYDROCARBON FUELS	3692
PREPARATION	3692
CHEMICAL SYNTHESIS	3692
PREPARATION FROM WASTES OR BIOMASS	3692
ALCOHOL FUELS	3692
PROPERTIES	3692
PREPARATION	3692
CHEMICAL SYNTHESIS	3692
PREPARATION FROM WASTES OR BIOMASS	3693
INORGANIC HYDROGEN COMPOUND FUELS	3693
PREPARATION	3693
SOLID WASTE FUELS	3693
LIQUID WASTE FUELS	3693
HYDRO ENERGY	3693
HYDRO ENERGY	3693
RESOURCES AND AVAILABILITY	3693
REGULATIONS AND LICENSING	3694
ENVIRONMENTAL ASPECTS	3695
SOLAR ENERGY	3695
RESOURCES AND AVAILABILITY	3695
ECONOMICS	3696
ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS	3696
SOLAR ENERGY CONVERSION	3696
PHOTOVOLTAIC CONVERSION	3696
BIOMASS PRODUCTION AND CONVERSION	3698
PHOTOVOLTAIC POWER PLANTS	3701
SOLAR THERMAL POWER PLANTS	3702
CENTRAL RECEIVER	3703
TOTAL ENERGY AND HYBRID SYSTEMS	3703
OCEAN THERMAL GRADIENT POWER PLANTS	3703
SOLAR RADIATION UTILIZATION	3703
SPACE HEATING AND COOLING	3703
AGRICULTURAL AND INDUSTRIAL PROCESS HEAT	3706
WATER HEATING	3708
OTHER	3708
SOLAR COLLECTORS AND CONCENTRATORS	3708
HEAT STORAGE	3712
GEOTHERMAL ENERGY	3712
RESOURCE STATUS AND ASSESSMENT	3713
GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS	3713
USA	3713
NON-USA	3713

Category	Page
GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY	3713
GEOCHEMICAL TECHNIQUES AND SURVEYS	3714
EXPLORATORY DRILLING AND WELL LOGGING	3714
LEGAL AND INSTITUTIONAL ASPECTS	3714
ECONOMIC AND FINANCIAL ASPECTS	3715
ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL	3715
GEOTHERMAL POWER PLANTS	3715
DESIGN AND OPERATION	3715
POWER PLANT SYSTEMS AND COMPONENTS	3715
GEOTHERMAL ENGINEERING	3715
DRILLING TECHNOLOGY AND WELL HARDWARE	3715
FLUID TRANSMISSION	3715
CORROSION, SCALING, AND MATERIALS DEVELOPMENT	3715
GEOTHERMAL RESERVOIR AND WELL PERFORMANCE	3716
RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY	3716
DIRECT ENERGY UTILIZATION	3716
PROPERTIES OF MINERALS AND ROCKS	3716
ISOTOPE AND TRACE ELEMENT STUDIES	3716
WIND ENERGY	3716
WIND ENERGY	3716
AVAILABILITY (CLIMATOLOGY)	3716
ECONOMICS	3716
ENVIRONMENTAL ASPECTS	3716
WIND ENERGY ENGINEERING	3717
APPLICATIONS	3717
TURBINE DESIGN AND OPERATION	3717
SITE CHARACTERISTICS	3717
ELECTRIC POWER ENGINEERING	3717
POWER PLANTS AND POWER GENERATION	3717
COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS	3717
WASTE-FUELED SYSTEMS	3717
COMPONENTS	3717
ECONOMICS	3718
OFF-PEAK ENERGY STORAGE	3718
FUELS	3718
ENVIRONMENTAL ASPECTS	3718
THERMAL EFFLUENTS	3718
NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL	3719
SITE SELECTION AND LAND USE	3719
POWER TRANSMISSION AND DISTRIBUTION	3719
AC SYSTEMS, EHV AND UHV	3719
DC SYSTEMS	3720
SUPERCONDUCTING AND CRYOGENIC SYSTEMS	3720
NUCLEAR POWER PLANTS	3720
NUCLEAR POWER PLANTS	3720
POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED	3720
POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED	3721
POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED	3721
POWER REACTORS, BREEDING	3721
REGULATION AND LICENSING	3722
ECONOMICS	3722
PROCESS HEAT REACTORS	3722
NUCLEAR REACTOR TECHNOLOGY	3722
THEORY AND CALCULATION	3722
FUEL ELEMENTS	3723
CONTROL SYSTEMS	3723
RESEARCH, TEST, AND EXPERIMENTAL REACTORS	3723
REACTOR SAFETY	3723
ENERGY STORAGE	3723
COMPRESSED GAS	3723
FLYWHEELS	3723
THERMAL	3724
CHEMICAL	3724
BATTERIES	3724
DESIGN AND DEVELOPMENT	3724
PERFORMANCE AND TESTING	3725
MATERIALS, COMPONENTS, AND AUXILIARIES	3725
ENERGY PLANNING AND POLICY	3726
ENERGY ANALYSIS AND MODELING	3726
ECONOMICS AND SOCIOLOGY	3727
ENVIRONMENT, HEALTH, AND SAFETY	3728
NATURAL RESOURCES	3728
RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION	3729
NUCLEAR ENERGY	3729
TRANSPORT AND STORAGE	3730
WASTE HEAT UTILIZATION	3730
CONSERVATION	3730
SUPPLY, DEMAND, AND FORECASTING	3730
POLICY, LEGISLATION, AND REGULATION	3731
FOSSIL FUELS	3732
COAL	3732
PETROLEUM	3732
NATURAL GAS	3732
HYDROGEN AND SYNTHETIC FUELS	3732
ELECTRIC POWER	3732
ELECTRIC POWER GENERATION	3735
ELECTRIC POWER TRANSMISSION AND DISTRIBUTION	3736
CONSUMPTION AND UTILIZATION	3736
UNCONVENTIONAL SOURCES AND POWER GENERATION	3736
SOLAR	3737
GEOTHERMAL	3737
OTHER	3737
ENERGY CONVERSION	3737
ENERGY CONVERSION	3737
MHD GENERATORS	3737
MATERIALS, COMPONENTS, AND AUXILIARIES	3737
DUCT ENGINEERING AND FLUID DYNAMICS	3737
THERMIONIC CONVERTERS	3737
FUEL CELLS	3737
DESIGN AND DEVELOPMENT	3737
PERFORMANCE AND TESTING	3738
MATERIALS, COMPONENTS, AND AUXILIARIES	3738
APPLICATIONS	3738
ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION	3738
ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION	3738
BUILDINGS	3739
RESIDENTIAL BUILDINGS	3740
OFFICE BUILDINGS	3742
SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS	3742
COMMERCIAL AND INDUSTRIAL BUILDINGS	3742
TRANSPORTATION	3742
AIR AND AEROSPACE	3742
RAILWAY	3743
LAND AND ROADWAY	3743
SEA AND WATER	3743
PIPELINE	3743
INDUSTRY AND AGRICULTURE	3743
ENERGY SOURCES	3743
EQUIPMENT AND PROCESSES	3743

Category	Page
WASTE HEAT RECOVERY AND UTILIZATION	3744
INDUSTRIAL WASTE MANAGEMENT	3744
MUNICIPALITIES AND COMMUNITY SYSTEMS	3744
PUBLIC UTILITIES	3744
MUNICIPAL WASTE MANAGEMENT	3746
EDUCATION AND PUBLIC RELATIONS	3746
ADVANCED AUTOMOTIVE PROPULSION SYSTEMS	3747
INTERNAL COMBUSTION ENGINES	3747
SPARK-IGNITION	3747
DIESEL	3747
TURBINE	3747
EXTERNAL COMBUSTION ENGINES	3747
STIRLING CYCLE	3747
RANKINE CYCLE	3747
ELECTRIC-POWERED SYSTEMS	3748
HYBRID SYSTEMS	3749
EMISSION CONTROL	3749
CARBON MONOXIDE	3749
HYDROCARBONS	3749
ALTERNATIVE FUELS	3749
MATERIALS	3751
METALS AND ALLOYS	3751
PREPARATION AND FABRICATION	3751
STRUCTURE AND PHASE STUDIES	3751
MECHANICAL PROPERTIES	3752
PHYSICAL PROPERTIES	3753
CORROSION AND EROSION	3754
RADIATION EFFECTS	3755
CERAMICS, CERMETS, AND REFRACTORIES	3756
PREPARATION AND FABRICATION	3756
STRUCTURE AND PHASE STUDIES	3756
MECHANICAL PROPERTIES	3757
PHYSICAL PROPERTIES	3757
CORROSION AND EROSION	3757
COMPOSITE MATERIALS	3757
PREPARATION AND FABRICATION	3757
MECHANICAL PROPERTIES	3757
PHYSICAL PROPERTIES	3757
POLYMERS AND PLASTICS	3758
MECHANICAL PROPERTIES	3758
PHYSICAL PROPERTIES	3758
OTHER MATERIALS	3758
PREPARATION AND MANUFACTURE	3758
STRUCTURE AND PHASE STUDIES	3758
PROPERTIES	3758
CORROSION, EROSION, AND DEGRADATION	3759
RADIATION EFFECTS	3759
CHEMISTRY	3759
ANALYTICAL AND SEPARATIONS CHEMISTRY	3759
ACTIVATION AND NUCLEAR REACTION PROCEDURES	3759
CHEMICAL PROCEDURES	3759
RADIOMETRIC AND RADIOCHEMICAL PROCEDURES	3759
SPECTRAL PROCEDURES	3759
SEPARATION PROCEDURES	3759
INORGANIC AND PHYSICAL CHEMISTRY	3760
CHEMICAL AND PHYSICOCHEMICAL PROPERTIES	3760
ISOTOPE EXCHANGE AND ISOTOPE SEPARATION	3760
ORGANIC CHEMISTRY	3760
CHEMICAL AND PHYSICOCHEMICAL PROPERTIES	3760
PHOTOCHEMISTRY	3760
RADIATION CHEMISTRY	3761
RADIOCHEMISTRY AND NUCLEAR CHEMISTRY	3761
PROPERTIES OF RADIOACTIVE MATERIALS	3761
RADIOISOTOPE PRODUCTION	3761
COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY	3761
ENGINEERING	3762
GENERAL ENGINEERING	3762
FACILITIES AND EQUIPMENT	3762
CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES	3763
PROTECTIVE STRUCTURES AND EQUIPMENT	3768
HANDLING EQUIPMENT AND PROCEDURES	3768
TRANSPORT AND STORAGE FACILITIES	3769
MINING AND DRILLING EQUIPMENT AND FACILITIES	3769
LASERS	3769
HEAT TRANSFER AND FLUID FLOW	3769
MATERIALS TESTING	3771
ELECTRONIC CIRCUITS AND DEVICES	3772
WASTE PROCESSING PLANTS AND EQUIPMENT	3773
COMBUSTION SYSTEMS	3773
UNDERGROUND ENGINEERING	3773
PARTICLE ACCELERATORS	3773
PARTICLE ACCELERATORS	3773
DESIGN, DEVELOPMENT, AND OPERATION	3773
BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS	3774
AUXILIARIES AND COMPONENTS	3774
ION SOURCES	3774
INJECTION AND EXTRACTION SYSTEMS	3775
EXPERIMENTAL FACILITIES AND EQUIPMENT	3775
STORAGE RINGS	3776
INSTRUMENTATION	3776
RADIATION INSTRUMENTATION	3776
GENERAL DETECTORS AND MONITORS	3776
HIGH ENERGY PHYSICS INSTRUMENTATION	3776
MISCELLANEOUS INSTRUMENTS	3777
EXPLOSIONS AND EXPLOSIVES	3777
CHEMICAL	3777
NUCLEAR	3778
ENVIRONMENTAL SCIENCES, ATMOSPHERIC	3778
BASIC STUDIES	3778
CHEMICALS MONITORING AND TRANSPORT	3778
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	3781
THERMAL EFFLUENTS MONITORING AND TRANSPORT	3782
SITE RESOURCE AND USE STUDIES	3782
REGULATIONS	3782
ENVIRONMENTAL SCIENCES, TERRESTRIAL	3782
BASIC STUDIES	3782
RADIOMETRIC TECHNIQUES	3783
CHEMICALS MONITORING AND TRANSPORT	3783
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	3783
SOIL	3783
TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS	3783
SITE RESOURCE AND USE STUDIES	3784
REGULATIONS	3784
ENVIRONMENTAL SCIENCES, AQUATIC	3784
ENVIRONMENTAL SCIENCES, AQUATIC	3784
BASIC STUDIES	3784
CHEMICALS MONITORING AND TRANSPORT	3785
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	3785
WATER	3785
AQUATIC ECOSYSTEMS AND FOOD CHAINS	3785
SITE RESOURCE AND USE STUDIES	3785
REGULATIONS	3785
ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES	3785
SOCIAL AND ECONOMIC STUDIES	3785

Category	Page
ASSESSMENT OF ENERGY TECHNOLOGIES	3785
ENVIRONMENTAL IMPACT STATEMENTS	3786
BIOMEDICAL SCIENCES, BASIC STUDIES	3786
BIOCHEMISTRY	3786
TRACER TECHNIQUES	3786
GENETICS	3786
METABOLISM	3786
TRACER TECHNIQUES	3786
MEDICINE	3786
UNSEALED RADIONUCLIDES IN DIAGNOSTICS	3786
EXTERNAL RADIATION IN DIAGNOSTICS	3787
MICROBIOLOGY	3787
MORPHOLOGY	3787
PATHOLOGY	3787
PHYSIOLOGICAL SYSTEMS	3787
TRACER TECHNIQUES	3787
AGRICULTURE AND FOOD TECHNOLOGY	3787
TRACER TECHNIQUES	3787
BIOMEDICAL SCIENCES, APPLIED STUDIES	3787
RADIATION EFFECTS	3787
RADIATION EFFECTS ON CELLS	3788
EXTERNAL SOURCE	3788
BASIC STUDIES	3788
APPLICATIONS	3788
RADIATION EFFECTS ON ANIMALS	3788
MAN	3788
VERTEBRATES	3788
RADIONUCLIDE EFFECTS - INTERNAL SOURCE	3788
MAN	3788
THERMAL EFFECTS	3789
PLANTS	3789
INVERTEBRATES	3789
VERTEBRATES	3789
CHEMICALS METABOLISM AND TOXICITY	3789
CELLS	3789
MICROORGANISMS	3789
PLANTS	3789
INVERTEBRATES	3789
VERTEBRATES	3790
MAN	3790
HEALTH AND SAFETY	3790
GEOSCIENCES	3791
GEOLOGY AND HYDROLOGY	3791
GEOPHYSICS	3791
SEISMOLOGY AND TECTONICS	3791
VOLCANOLOGY	3791
GEOPHYSICAL SURVEY METHODS	3791
MINERALOGY, PETROLOGY, AND ROCK MECHANICS	3791
GEOCHEMISTRY	3792
OCEANOGRAPHY	3792
PHYSICS RESEARCH	3792
ASTROPHYSICS AND COSMOLOGY	3792
COSMIC RADIATION	3792
STARS	3792
QUASI-STELLAR, RADIO, AND X-RAY SOURCES	3793
GALAXIES	3793
COSMOLOGY	3793
ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS	3793
BEAMS AND THEIR REACTIONS	3793
ATOMIC AND MOLECULAR PROPERTIES	3794
POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES	3794
COLLISION PHENOMENA	3795
ATOMIC AND MOLECULAR THEORY	3795
FLUID PHYSICS	3796
GENERAL FLUID DYNAMICS	3796
PROPERTIES AND STRUCTURE OF FLUIDS	3796
MAGNETOHYDRODYNAMICS	3796
HIGH ENERGY PHYSICS	3796
PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL	3796
ELECTROMAGNETIC INTERACTIONS	3796
WEAK INTERACTIONS	3797
STRONG BARYON-INDUCED INTERACTIONS	3797
STRONG MESON-INDUCED INTERACTIONS	3797
PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL	3797
GENERAL	3797
ELECTROMAGNETIC INTERACTIONS	3798
WEAK INTERACTIONS	3798
STRONG INTERACTIONS, GENERAL	3798
STRONG INTERACTIONS, BARYON NO.=0	3798
STRONG INTERACTIONS, BARYON NO.=1	3799
STRONG INTERACTIONS, BARYON NO. GREATER THAN 1	3799
PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES	3799
GENERAL	3799
FIELD THEORY	3799
SCATTERING THEORY	3799
PHYSICS RESEARCH	3800
NUCLEAR PHYSICS	3800
NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL	3800
MASS, ABUNDANCE, AND BINDING ENERGY	3800
NUCLEAR REACTIONS AND SCATTERING	3800
NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL	3800
NUCLEAR REACTIONS AND SCATTERING	3800
NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL	3801
ENERGY LEVELS AND TRANSITIONS	3801
NUCLEAR REACTIONS AND SCATTERING	3801
NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL	3801
MASS, ABUNDANCE, AND BINDING ENERGY	3801
NUCLEAR REACTIONS AND SCATTERING	3801
NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL	3801
ENERGY LEVELS AND TRANSITIONS	3801
NUCLEAR REACTIONS AND SCATTERING	3801
NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL	3801
MASS, ABUNDANCE, AND BINDING ENERGY	3801
ENERGY LEVELS AND TRANSITIONS	3801
NUCLEAR REACTIONS AND SCATTERING	3802
NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL	3802
ENERGY LEVELS AND TRANSITIONS	3802
NUCLEAR REACTIONS AND SCATTERING	3802
NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL	3802
ENERGY LEVELS AND TRANSITIONS	3802
NUCLEAR REACTIONS AND SCATTERING	3802
NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL	3802
ENERGY LEVELS AND TRANSITIONS	3802
NUCLEAR REACTIONS AND SCATTERING	3802
NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL	3802
RADIOACTIVE DECAY	3802
ENERGY LEVELS AND TRANSITIONS	3803
NUCLEAR REACTIONS AND SCATTERING	3803
NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL	3803
ENERGY LEVELS AND TRANSITIONS	3803
NUCLEAR REACTIONS AND SCATTERING	3803
NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL	3803
ENERGY LEVELS AND TRANSITIONS	3803

Category	Page
MOMENTS AND SPIN	3803
NUCLEAR REACTIONS AND SCATTERING	3803
NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL	3803
ENERGY LEVELS AND TRANSITIONS	3804
NUCLEAR REACTIONS AND SCATTERING	3804
NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL	3804
MASS, ABUNDANCE, AND BINDING ENERGY	3804
RADIOACTIVE DECAY	3804
ENERGY LEVELS AND TRANSITIONS	3804
NUCLEAR REACTIONS AND SCATTERING	3804
SPONTANEOUS AND INDUCED FISSION	3804
NUCLEAR THEORY	3804
NUCLEAR STRUCTURE	3804
NUCLEAR MATTER	3805
NUCLEAR REACTIONS AND SCATTERING	3805
SPONTANEOUS AND INDUCED FISSION	3805
NUCLEAR MODELS	3806
RADIATION AND SHIELDING PHYSICS	3806
RADIATION PHYSICS	3806
NEUTRON INTERACTIONS WITH MATTER	3806
MEDICAL PHYSICS	3806
DOSIMETRY	3806
SOLID STATE PHYSICS	3806
SUPERCONDUCTIVITY	3807
GENERAL THEORY	3807
ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA	3807
THEORETICAL PHYSICS	3808
CLASSICAL AND QUANTUM MECHANICS	3808
OPTICS	3808
STATISTICAL PHYSICS AND THERMODYNAMICS	3808
ELECTRICITY AND MAGNETISM	3809
MATHEMATICAL PHYSICS	3809
COMMUNICATION, EDUCATION, HISTORY, AND PHILOSOPHY	3809
FUSION ENERGY	3809
PLASMA RESEARCH	3809
PLASMA CONFINEMENT AND HEATING	3809
PLASMA DIAGNOSTICS	3809
PLASMA KINETICS - EXPERIMENTAL	3810
PLASMA KINETICS - THEORETICAL	3810
PLASMA INSTABILITIES	3811
PLASMA WAVE PHENOMENA	3811
FUSION POWER PLANT TECHNOLOGY	3811
BLANKET ENGINEERING	3811
MAGNET COILS AND FIELDS	3811
HEATING AND FUELING SYSTEMS	3811
TRITIUM PROCESSING, ENVIRONMENT AND SAFETY	3812
INERTIAL CONFINEMENT TECHNOLOGY	3812
COMPONENT DEVELOPMENT AND MATERIALS TESTING	3813
GENERAL AND MISCELLANEOUS	3814
MANAGEMENT	3814
MATHEMATICS AND COMPUTERS	3814
INFORMATION HANDLING	3816
CORPORATE INDEX	1C
AUTHOR INDEX	19A
SUBJECT INDEX	41S
CONTRACT NUMBER INDEX	122CN
REPORT NUMBER INDEX	129R

Volume 5, Number 21, November 15, 1980

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

33171 (DOE/FE—0009) **University contracts summary book.** (Department of Energy, Washington, DC (USA)). Aug 1980. 537p. NTIS, PC A23/MF A01.

The principal objectives of the Fossil Energy Program are to seek new ideas, new data, fundamental knowledge that will support the ongoing programs, and new processes to better utilize the nation's fossil energy resources with greater efficiency and environmental acceptability. Toward this end, the Department of Energy supports research projects conducted by universities and colleges to: Ensure a foundation for innovative technology through the use of the capabilities and talents in our academic institutions; provide an effective, two-way channel of communication between the Department of Energy and the academic community; and ensure that trained technical manpower is developed to carry out basic and applied research in support of DOE's mission. Fossil Energy's university activities emphasize the type of research that universities can do best - research to explore the potential of novel process concepts, develop innovative methods and materials for improving existing processes, and obtain fundamental information on the structure of coal and mechanisms of reactions of coal, shale oil, and other fossil energy sources. University programs are managed by different Fossil Energy technical groups; the individual projects are described in greater detail in this book. It is clear that a number of research areas related to the DOE Fossil Energy Program have been appropriate for university involvement, and that, with support from DOE, university scientific and technical expertise can be expected to continue to play a significant role in the advancement of fossil energy technology in the years to come.

33172 (NP—25053) **Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979.** (Fuel Research Inst. of South Africa, Pretoria). 1979. 84p. NTIS (US Sales only),PC A05/MF A01.

This annual report reviews South Africa's production of coal in 1979 and its uses or exports (including grading for export), exploration, research programs, efficiency cuts on coal preparation plants, and the analyses and calorific value of samples of coal from individual mines. Some work is being done in nearly all the major research areas. (LTN)

PROCESSING

33173 (ANL—80-46) **Materials technology for coal-conversion processes. Progress report, January-March 1980.** (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01.

The program entails nondestructive testing, failure analysis, and studies of erosive wear, corrosion, and refractory degradation. Analysis of recent refractory-slag interaction tests suggests that as the chromia content is increased from 10 to 32%, the primary reaction product changes from calcium hexaluminate to spinel, significantly increasing the corrosion resistance of the refractory. Field reliability of the high-temperature ultrasonic erosion scanner was demonstrated at both a coal liquefaction plant (SRC at Tacoma, WA) and a coal gasification plant (Morgantown, WV). Continuous high-temperature operation has been demonstrated and an accuracy of +-0.025 mm seems achievable. Equipment has been ordered for field tests of passive acoustic systems at Exxon. This includes a four-channel tape recorder, differential amplifiers, and signal conditioners. Corrosion studies have been completed on effects of multicomponent gas environments on corrosion mechanisms and uniaxial tensile properties of Fe-Ni-Cr alloys. Results of these and other tests utilizing 10,000-h exposures suggest that corrosion rates of 0.6 mm/y can be expected. Failure analysis activities included studies of compressor diaphragms from the Grand Forks Energy Technology Center coal-liquefaction continuous-process unit. Cracks were found in two of the three diaphragms. Failure of an internal solids transfer line from HYGAS appears to have been caused by severe localized sulfidation of the high-nickel Inconel 182 weld metal used to fabricate the line.

33174 **Environmental control in synfuels processes. Catalytic reactions involving synthesis gas.** Washington, DC; American Chemical Society (1979). 210p. (CONF-800303—P3). Univ. Microfilms, Ann Arbor, MI $8.00.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The Spring meeting of the American Chemical Society, Division of Fuel Chemistry, was held at Houston, Texas, March 23 to 28, 1980. Symposia involved environmental control in synfuels processes (abstracts only), catalytic reactions involving synthesis gas and general papers. Thirteen papers have been entered individually into EDB and ERA. Two papers had been entered previously from other sources. (LTN)

33175 **Cyano-arenes produced by combustion of nitrogen-containing fuels.** Dubay, G.R.; Hites, R.A. (Massachusetts Inst. of Tech., Cambridge). Contract EE-77-S-02-4267. *Environ. Sci. Technol.;* **12**: 5-8(Aug 1978).

Cyanonaphthalenes (both isomers) and cyanoacenaphthylenes (four isomers) were identified in the soot generated by the combustion of aromatic hydrocarbon fuels doped with 6 to 30% pyridine. These were by far the most abundant nitrogen-containing organic compounds in this combustion effluent; multiring, nitrogen heterocyclic compounds, such as those commonly observed in airborne particulate matter, were a minor component. These identifications were made by gas chromatographic mass spectrometry following a preliminary separation by alumina column chromatography. The environmental significance of these findings is discussed. 1 figure, 2 tables.

33176 **Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes.** Harris, J.J. Grand Forks, ND; University of North Dakota (1978). 28p. (NP—25064).

The status and prospects of pipeline gas from coal technologies are examined from an economic point of view. First, principal coal gasification processes are described briefly and their stages of technological development are indicated. Capital and input operating requirements are discussed next. Estimates of unit gas cost or required selling price are made from the standpoint of private unregulated operation and from the standpoint of private-regulated operation of the processes. Lastly, commercialization prospects of these technologies are assessed from the standpoint of need, capital risk, profitability, and thermal efficiency. The role of these synthetic gas technologies is now regarded as uncertain, although just a few years ago their prospects were viewed quite optimistically. Now most observers feel it would be fortuitous if 10 gas plants are operating by 1985, but the probabilities are very low given the present political and economic climate. Reasons as to why synthetic coal gasification technologies are expected to be of minor importance are not hard to identify. One of these reasons is obvious from the preceding section, namely, the tremendous capital cost of these plants. The financing of a billion dollar plant poses a difficult problem of raising equity and debt-capital funds for any firm contemplating construction of a coal gasification plant. Few private firms, if any, could finance this amount from retained earnings and each would have to rely on the capital market to a major extent. Here a problem would be encountered also. Investors would be reluctant to buy bonds or stocks in an untried venture because of the

financial risks involved. The financial risk would be substantial because the market for this gas is not assured since the price required to cover the average cost of production would be higher than the price of competing fuels from domestic or foreign sources.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 33574

33177 (ANL/CEN/FE—80-4) **Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979.** Johnson, I.; Swift, W.M.; Lee, S.H.D.; Jonke, A.A. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01.

This work supports the program to develop methods for the cleanup of combustion gases from pressurized fluidized-bed coal combustors so that the cleaned gases can be used for downstream gas turbines. This report presents the results of studies to develop granular sorbents for removing gaseous alkali metal compounds from high-temperature high-pressure combustion gases. Activated bauxite, one of the sorbents found to be effective, can be reused after removal of the alkali compound by a water-leaching process. Results of testing of this leaching process are reported. An experimental appartus for testing sorbents at high pressure has been built; results of preliminary tests are reported.

33178 Photolytic process for gasification of carbonaceous material. Zenty, S. (to Solarco Corp.). US Patent 4,177,120. 4 Dec 1979. Filed date 14 Apr 1978. 14p.

Process and apparatus are disclosed for converting carbon dioxide to carbon monoxide by subjecting the carbon dioxide to radiation in the presence of carbonaceous material such as coal to form carbon monoxide. The preferred form of radiation is solar energy, and the process is preferably carried out in an atmosphere essentially free of oxygen. The invention also includes subjecting carbon monoxide to radiation to form purified carbon and useful heat energy. The two procedures can be combined into a single process for converting solar or other energy into useful thermal energy with the production of useful products. The reactor apparatus is specifically designed to carry out the radiation-induced conversions. Coal can be desulfurized and its caking characteristics altered by solar radiation in the presence of suitable gases. 3 figures.

33179 Removal of organic sulfur from coal: the use of liquid sulfur dioxide. Burow, D.F.; Glavincevski, B.M. (Univ. of Toledo, OH). Contract ET-78-G-01-3316. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 153-164(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The utility of liquid SO_2 for the removal of organic sulfur from several Eastern bituminous coals has been explored. Reactions were carried out in sealed fritted glass tubes at elevated temperatures; after subsequent washing, the coal was analyzed for sulfur content. Approximately 40% of the organic sulfur could be removed in these simple exploratory experiments. In addition, comminution of most of the coals occurred and a portion of the coal was extracted. The extract from selected coals was characterized by thin-layer chromatography, by nmr (^1H and ^{13}C) and infrared spectroscopy, and by field-ionization mass spectrometry. For comparison, extractions with phenol and p-cresol, under similar conditions, were also examined. The results of these preliminary investigations warrant further research to establish optimum conditions for the removal of sulfur compounds from coal by treatment with liquid SO_2 and to facilitate removal of residual SO_2 from the coal.

HYDROGENATION

33180 Pyrolysis and hydrogenation process. Duraiswamy, K.; Winter, B.L. (to Occidental Petroleum Corp.). US Patent 4,166,786. 4 Sep 1979. Filed date 12 Dec 1977. 24p.

In a continuous process for recovery of values from a solid carbonaceous material, the carbonaceous material is pyrolyzed in the presence of a particulate source of heat to yield a particulate carbon containing residue of pyrolysis and volatilized hydrocarbons while simultaneously the volatilized hydrocarbons are hydrogenated. The particulate source of heat is formed by oxidizing carbon in the solid residue to heat the particles. Hydrogen for hydrogenation is obtained by reacting at least a portion of the hot particulate carbon containing residue of pyrolysis with steam prior to feeding the hot particulate residue to the pyrolysis reaction zone. Steam and/or carbon dioxide can be introduced into the pyrolysis reaction zone to react with carbon containing residue contained therein. The particulate source of heat can be introduced to the pyrolysis reaction zone over an overflow weir. The hydrogen and the particulate source of heat can be formed simultaneously in an oxidation-conversion zone. The volatilized hydrocarbons can be further hydrogenated in a vapor hydrogenation zone. 7 figures.

33181 Applied Fischer-Tropsch kinetics for a flame sprayed iron catalyst. Thomson, W.J.; Arndt, J.M.; Wright, K.L. (Univ. of Idaho, Moscow). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 101-118(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Fischer-Tropsch synthesis is highly exothermic and consequently a good deal of attention has been spent on reactor design considerations. Designs ranging from slurry reactors to fluidized beds have been proposed and, in the latter case, actually constructed. It is also common to utilize recycle reactors in order to restrict the temperature rise across the catalyst bed, but a heavy price must be paid in terms of compressor costs. A low pressure drop reactor utilizing parallel plates and inserts coated with catalyst was first proposed by DOE for the exothermic methanation reaction and a similar design using iron catalysts for Fischer-Tropsch has been discussed by Haynes, et al. The work reported here deals with an applied kinetics study utilizing this catalyst concept. While the scope of the project is concerned with product distributions as well as reaction rates, in this paper we only focus on reactant and make-gas rates.

GASIFICATION

REFER ALSO TO CITATION(S) 33178, 33180, 33220, 33226, 33361, 33887, 33904, 33934

33182 (DOE/ET/10254—82) **Test and evaluate the TRI-GAS Low-Btu Coal Gasification Process. Quarterly report, April-June 1980. (Bituminous Coal Research, Inc., Monroeville, PA (USA)).** Jul 1980. Contract AC01-78ET10254. 14p. (BCR-L—1115). NTIS, PC A02/MF A01.

Four tests were conducted in the TRI-GAS PEDU. Test No. 3S-55 was prematurely shut down because of failure of the steam boiler. Steady-state operation was not achieved. Following repairs to the steam boiler, Test No. 3S-56 was conducted. This test was also terminated prematurely, due to failure of the power controller for the steam boiler. Repairs were again made. In Test No. 3S-57, bed temperatures in Stages 2 and 3 were lower than required for gasification, although some reaction occurred at the top of the reactors where the temperatures exceeded 1600°F. The test was concluded somewhat prematurely due to plugging of the coal-feed line. PEDU Test No. 3S-58, an integrated three-stage test, was conducted in June. The heating value of the product gas was about 100 Btu per cu ft even though failure of the reactor heaters prevented the Stage 2 temperature from exceeding 1550°F.

33183 (DOE/ET/14815—12) **Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980.** Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Jul 1980. Contract AC01-79ET14815. 24p. NTIS, PC A02/MF A01.

Only one bench-scale reactor test was completed. The Harshaw Ni/Cu/Mo and UCI (composition undisclosed) catalysts were evaluated over a 12-day period at 800 F and a feed gas H_2/CO ratio of 2/1. Initial conversions with both catalysts were about 33 percent; and the activities of both samples declined steadily during the test, with final conversion values in the 15 to 20 percent range. During this test, problems were experienced with water carryover into the Drierite traps, necessitating some major design changes in the water letdown system. Two subsequent attempts to initiate a second test at 950 F with these catalysts were unsuccessful for the reasons given. A 5-day PEDU test (Test SM-2) was conducted using the spent Harshaw Ni/Cu/Mo catalyst from Test SM-1 in February. The purpose was to continue the data period at $H_2/CO = 1/1$ that was terminated prematurely during the earlier PEDU test. After a brief baseline period ($H_2/CO = 3/1$), during which catalyst activity appeared to be normal, the feed gas was changed to approximately 31 percent H_2, 31 percent CO, 22 percent CO_2, and 16 percent CH_4; and steam was added to the feed. Some difficulty was experienced in maintaining high bed temperatures, with the result that the steam flow had to be gradually decreased. This may have enhanced catalyst coking, since the catalyst activity generally declined slowly throughout the test, and the final carbon content of the catalyst was 3.6 percent (vs. 2.0 percent at the beginning of the test). A second 5-day PEDU test (Test SM-3) was conducted using the Climax Ni/Mo catalyst. The results are described.

33184 (DOE/METC/SP—80/8) **Rockwell Coal Lock Hopper Valve: METC SOA Test Valve No. A-16. State-of-the-art Lock Hopper Valve Testing and Development Project. Summary test report.** Gardner, J.R.; Hall, R.C.; Hornbeck, R.G.; Griffith, R.A.; Galvin, W.E.; Gayheart, T.R.; Maxfield, D.A. (TRW Energy Systems Planning Div., Morgantown, WV (USA)). Jul 1980. Contract AB21-80MC14522;AT21-80MC14085. 64p. NTIS, PC A04/MF A01.

The Rockwell Lock Hopper Valve, METC Test Valve No. A-16, has accumulated over 1000 operating cycles in the Valve Static Test Unit and over 8500 operating cycles in the Valve

Dynamic Test Unit. Valve performance with a test media of coarse (less than 1/4 inch but 90 percent retained on 16 mesh) limestone, indicates good potential for solids handling lock hopper service. Operating problems were encountered with fine, caking limestone. Some sealing problems, requiring opening and reclosing the valve, and the seat damage observed show that improvements are needed in the seat design and/or seat purge system. The valve's maintainability was demonstrated by removing the body seat and the disk and refacing them. Valve performance after rework was comparable to initial performance.

33185 (FE—2012-096(App.)) **Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET-13031. 194p. NTIS, PC A09/MF A01.

33186 (FE—2012-096(Sect.4)) **Pipeline Gas Demonstration Plant. Phase I. Process evaluation report, conceptual commercial plant.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET13031. 342p. NTIS, PC A15/MF A01.

This Process Evaluation Report (PER) contains the results and recommendations of comprehensive analyses and studies which were made to optimize the ICGG Commercial Plant Baseline Process Concept for producing synthetic pipeline gas (SPG) from coal. Design studies to optimize the thermal efficiency and economic attractiveness of the COGAS Process Areas of the plant were conducted along with design studies and trade-off studies of available process subsystems to complement the COGAS Process Areas. The results, recommendations and description of the work accomplished in developing the PER are contained in six separately bound sections. Section 4 describes those trade-off studies which were made to select processes which would best complement the COGAS Process Areas and provide the most efficient and economical Commercial Plant Concept.

33187 (FE—3125-21) **Advanced development of a short-residence-time hydrogasifier. Quarterly technical progress report, April 1, 1980-June 30, 1980.** Friedman, J. (Rockwell International Corp., Canoga Park, CA (USA). Environmental and Energy Systems Div.). Jul 1980. Contract AC01-78ET10328. 161p. NTIS, PC A08/MF A01.

Efforts in the development of the Rockwell single-stage short-residence-time hydrogasifier for the gasification of coal and peat are reported. These involve test results, the design and construction of a 3/4-TPH coal feed rate integrated process development unit, materials and engineering studies for a commercial plant, process optimization, hydrogen production studies, utilization of chars, economic analysis and analytical evaluation of experiments with peat. (LTN)

33188 (IFSM—80-104) **Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report.** Wei, R.P.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA (USA)). May 1980. Contract AS01-76ET10647. 72p. NTIS, PC A04/MF A01.

Steels used in coal gasification vessels and piping (externals) can be exposed to mixtures of hydrogen, water vapor (steam), hydrogen sulfide, methane, carbon monoxide, carbon dioxide, and other gases at temperatures and pressures up to 600°K and 10 MPa. Such mixtures, under certain operating conditions, can either enhance or inhibit crack growth in these steels. To assist in identifying and establishing the conditions for this enhancement or inhibition, fracture mechanics and surface chemistry experiments on the kinetics of fatigue crack growth, and on the thermodynamics and kinetics of surface reactions were carried out on a 2-1/4Cr-1Mo (ASTM A542, Class 2) steel. The results indicate considerable enhancement of fatigue crack growth by hydrogen sulfide, hydrogen, and water vapor. The degree of enhancement is related to the reactivity of these gases with the steel. Furthermore, the results indicate that the apparent immunity of this steel to stress corrosion cracking does not imply the same immunity to corrosion fatigue. Surface chemistry studies show the reactions of air, oxygen and water vapor with this steel to be consistent with those observed previously with iron and AISI 4340 steel. An important new finding is the enhanced segregation of sulfur to free surfaces during heating in hydrogen. The crack growth data are discussed in terms of the influences of temperature, gas pressure and loading variables, and are interpreted in terms of gas transport and chemical reaction kinetics. Quantitative modeling of environment enhancement and inhibition of fatigue crack growth is considered, and the implications of fracture mechanics and surface chemistry data are discussed. Preliminary studies of fatigue crack growth in mixtures of H_2S and CO indicate that CO reduces the effectiveness of H_2S in enhancing crack growth.

33189 (FE—2012-096(Sect.1)(Exec.Summ.)) **Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET13031. 46p. NTIS, PC A03/MF A01.

The Process Evaluation Report (PER) studies confirmed the technical and economic feasibility of the Commercial Plant concept, and significant improvements were identified for several areas of the plant. Total capital requirements were reduced by 14% relative to the baseline economics presented. More importantly, a substantial increase in process thermal efficiency (62.4% to 68%) coupled with a change in by-product outputs produced a 16.9% reduction in net operating cost. These combined savings (in end 1977 dollars) resulted in an 80 cent/MM Btu decrease in the estimated gas selling price. Marketability studies indicate that a gas selling price of $3.79/MM Btu (as opposed to $4.59/MM Btu for the tentative baseline design), projected by using DOE guidelines, is at a level where synthetic pipeline gas can be considered a viable alternate source of gas supply. The results, recommendations and description of the work accomplished are described briefly.

33190 **Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts.** Moeller, A.D.; Bartholomew, C.H. (Brigham Young Univ., Provo, UT). Contract EF-76-C-01-1207. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 54-70(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

At 723 K and atmospheric pressure deactivation of nickel catalysts by carbon exhibited first order dependence on CO concentration (second order overall). Half-lives of Ni and Ni-Mo catalysts varied from 13-170 hours. Based on the specific intrinsic activities after reaction under carbon depositing conditions, the order of decareasing resistance to carbon deposition at low pressure was: Ni, Ni (pre-sulfided), Ni-Mo-Cu, Ni-Mo, Ni-Mo-Cu (pre-sulfided). During reaction in a fixed bed at high temperatures and pressures, little apparent deactivation was observed except in the case of Ni-Mo-Cu. Ni-Mo is more resistant to carbon deposition in a fluidized bed than Ni-Mo-Cu. The fluidized bed experiments provide a more realistic indication of the true deactivation behavior because temperature and reactant concentrations are more uniform than in a fixed bed. Pre-sulfiding the catalysts does not improve their tolerance to carbon deposition. In fact, pre-sulfiding Ni-Mo-Cu severely degraded its performance under severe carbon deposition conditions. It is believed that sulfur poisons the gasification of active carbon leading to a build up and transformation to inactive carbon. A low pressure dilute air mixture at 573 K regenerates most carbon fouled catalysts. Using a dilute O_2 mixture at high pressure results in CH_4 turnover numbers and CH_4 yields which are temporarily higher than for fresh catalysts. Regeneration using air or O_2 results in a significant loss of surface area, but it may be the only practical method due to temperature limitations of industrial equipment.

33191 **Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics.** Rao, V.U.S. (Pittsburgh Energy Technology Center, PA); Gormely, R.J.; Pennline, H.W.; Schneider, L.C.; Obermyer, R. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 119-126(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Our experiments lead to the following conclusions: (1) Zeolite acidity plays an important role in the formation of aromatics from synthesis gas by bifunctional catalysts as strikingly evidenced in a comparison of the product slates from ZSM-5 (11.1% Fe) and Silicalite (13.6% Fe). (2) The transition metal component impregnated into the zeolite plays an important role in selectivity as seen from the liquid phase products from ZSM-5 (11.1% Fe) and ZSM-5 (5.6% Fe, 4.5% Co). In this context, zeolites containing bimetallic clusters are of special interest. (3) Silicalite impregnated with Fe and promoted with K has an exceptionally high selectivity for the production of C_2-C_4 olefins from synthesis gas.

33192 **Coal gasification chemistry. Flash hydrogenation reactions of coal. Pyrolysis reactions of coal. Government role in fuels R & D. Henry H. Storch award symposium.** Washington, DC; American Chemical Society (1979). 303p. (CONF-790917—P3). University Microfilms, Ann Arbor, MI $11.00.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The fall meeting of the American Chemical Society, Division of Fuel Chemistry, was held in Washington, DC, September 10 to 14, 1979. The meeting considered coal gasification chemistry, flash hydrogenation reactions of coal, pyrolysis reactions to coal, government role in fuel R and D, Henry H. Storch award symposium, and general papers. Twenty-seven papers from Volume 24, No. 3, preprints have been entered individually into EDB and ERA and one also into EAPA. Three papers had been entered previously from other sources. (LTN)

33193 **Effects of coal structure and processing conditions on organic effluents from slagging fixed-bed gasification.** Olson, J.K.;

Schobert, H.H. (Grand Forks Energy Technology Center, ND). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 3, 2-9(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The carbon content of the coal plays the most predominant role in determining the relative amounts of compound types in the organic extracts from tar and liquor. An increase in maf carbon will increase the percentage of paraffins and olefins and aromatics in the tar and will increase the percentage of polar compounds in the liquor extract. The polar fraction in the tar extract decreases as maf carbon in the coal increases. The oxygen content of the coal correlates inversely with the amount of organic material extractable from the liquor. Since the carbon content of the coal is of great importance in determining the molecular framework, and since the oxygen is the major contributor to heteroatomic functional groups, these results show that the effluent composition is dependent upon the molecular structure of the coal. Other coal-specific characteristics of the SFBG effluents include the volatility of the tar and the nature of the inorganic materials exiting the gasifier in the raw gas.

33194 Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere. Walker, P.L. Jr.; Mahajan, O.P.; Komatsu, M. (Pennsylvania State Univ., University Park). Contract EX-76-C-01-2030. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 3, 3, 10-16(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

We have previously reported reactivities of a vast spectrum of coal-derived chars in air, CO_2, steam and H_2. In oxidizing atmospheres, char reactivity decreases with increase in the rank of the parent coal. In contrast, char reactivity in H_2 shows little dependence on rank of the coal precursor. Lignites and subbituminous coals contain significant amounts of carboxylic acid groups, where a fraction of the H^+ ions have been exchanged by different cations such as Na^+, K^+, and Ca^{++}, as a result of extended contact with ground water containing different salts. The higher reactivity of lignite and sub-bituminous coal chars in oxidizing atmospheres is thought to be due, at least in part, to the presence of exchangeable metal cations. Therefore, it is desirable to study the possible catalytic effect of different exchangeable cations present on the surfaces of these coals on subsequent char reactivity in different atmospheres. This paper describes the results of such a study. A Darco (Texas) lignite was demineralized by boiling with 10% HCl and subsequently with a 50-50 mixture of 50% HF-10% HCl. The carboxyl content of the demineralized coal was 2.4 mmoles/g. Schafer's method was used to effect cation-exchange. Raw, Dem and cation-exchanged samples were carbonized in N_2 in a fluidized bed. Reactivities of various char samples were measured in air CO_2, steam, and H_2 mixture. The results clearly show that the replacement of surface H^+ ions of carboxylic acid groups present on the surface of Dem lignite by metal cations increases the reactivity of the chars produced, but the extent of the increase is markedly dependent upon the nature of the cation.

33195 Electrochemical route to coal gasification and its technological implications. Coughlin, R.W.; Farooque, M. (Univ. of Connecticut, Storrs). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 3, 41-51(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

It has been shown in this study that: (i) different coals have different reactivities for electrochemical gasification and in each case the reactivity of the particular coal falls gradually as the reaction advances; (ii) the original reactivity of the coal samples can be restored by acetone washing and heating at temperatures between 200° - 600°C; (iii) high temperature operation promises several advantages; (iv) two different coal oxidation mechanisms appear to occur in two correspondingly different potential regions of oxidation; and (v) hydrogen production and electrowinning of metals from aqueous electrolytes are the processes where electrochemical coal gasification may find application. Mass balance calculations, high temperature reaction and use of anodes other than platinum are currently in progress.

33196 Flash hydropyrolysis of lignite and sub-bituminous coals to both liquid and gaseous hydrocarbon products. Fallon, P.T.; Bhatt, B.; Steinberg, M. (Brookhaven National Lab., Upton, NY). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 3, 52-63(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Flash Hydropyrolysis (FHP) is a short residence time (1 to 10 sec) gas phase noncatalytic coal hydrogenation process in which coal is converted directly to liquid and gaseous hydrocarbon products. Pulverized coal is contacted with hydrogen at elevated pressure and heated at average rates of 20,000 to 30,000°C/sec causing thermally-induced fractures in the polycyclic structure of the coal molecule. The free radicals formed readily add on hydrogen thus increasing the hydrogen to carbon ratio of 0.8 in the feed coal to approximately 1 to 4 depending upon whether liquid or gaseous hydrocarbons are formed. The products are then rapidly quenched to terminate the reaction and to prevent any decomposition or recombination. The following conclusions can be drawn from this work so far. The maximum yield of BTX observed from the FHP of sub-bituminous coal is at least 50% greater than that from lignite (10% for lignite and 15% for sub-bituminous). The total liquids yield (BTX + $\geq C_6$) are approximately the same for both coals (~18-20%). Both coals can be hydrogasified to methane and ethane up to approximately 85% of the total carbon in the fuel at 2500 psi and 875° to 900°C. The sub-bituminous coal yields 60% more gaseous hydrocarbons at 1000 psi and 875° to 900°C than the lignite. The gaseous yield from both coals is directly proportional to the hydrogen pressure in the range of 500 to 2500 psi. Negligible quantities of the sulfur or nitrogen in the coal are found in the liquid hydrocarbon products. The FHP reactions are basically chemical rate and not diffusion rate controlled. In the commercial application of FHP, a mixed product slate of liquids and gases is the most economical.

LIQUEFACTION

REFER ALSO TO CITATION(S) 33180, 33191, 33192, 33196, 33217, 33226, 33887

33197 (BMFT-FB-T—80-033) Erection and operation of a Fischer-Tropsch-pilot plant with liquid-phase reactor. Hubert, H.J. (Schering A.G., Bergkamen (Germany, F.R.)). Jul 1980. 144p. (In German). NTIS (US Sales Only), PC A07/MF A01.

Of the FT-products the C_2/C_4 olefins are important raw materials for the chemical industries, but so far made out of crude oil. It is intended to increase the yield of C_2/C_4 olefins by using new catalysts and by variation of reaction conditions. The preferred equipment are liquid-phase vessels which run almost isothermally. Sasol and Ruhrchemie catalysts have been tested, also iron-whisker and iron-manganese. The C_2/C_4 yield so far has been increased from less than 40 g to more than 60 g/m³ (V/sub n/) H_2 + Co. The trials will be continued.

33198 (DOE/ET/11328—T1) Demonstration plant supplementary technical studies section 10-confidence analysis. SRC-II demonstration project, phase zero, task number 1, deliverable number 3. (Pittsburg and Midway Coal Mining Co., Denver, CO (USA)). 31 Jul 1979. Contract AC01-78ET11328. 115p. NTIS, PC A06/MF A01.

The Gulf Management Sciences Group (GMSG) in Pittsburgh was asked to provide assistance in performing a confidence analysis for the SRC-II demonstration plant as required by the Department of Energy. Specifically, the contract says to discuss confidence levels for plant operating and capital costs; plant operability and technical risk. It was decided that the best way to obtain estimates for these variables would be through interviews of people with substantial experience in the field. Each subject was first asked what modifications he envisioned being made to the current plant design. Discussion was limited to major systems that might require partial redesign and comments concerning the plant in general. The interviewees were next asked to estimate the probability of success for the project, given that the modifications they envisioned were in fact made. The modes of the combined distributions of the interview results indicate that the respondents in general felt that the base case estimates represented the most probable outcomes with the possible exception of the capital cost estimate. On the other hand, the respondents consistently judged that there is a chance that the demonstration plant will perform significantly worse than the base case for each of the variables that were projected. This conclusion is supported by the skewness of the distributions. These distributions can be expected to narrow and some of the skewness will disappear as the final design of the plant is determined. A detailed analysis of the methodology employed is presented. (LTN)

33199 (DOE/ET/13381—T1) Low temperature chemical fragmentation of coal. Deno, N.C.; Curry, K.; Jones, A.D.; Minard, R.; Potter, T.; Rakitsky, W.; Wagner, K.; Yevak, R.J. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AS01-78ET13381. 13p. NTIS, PC A02/MF A01.

Trifluoroperoxyacetic acid chemically fragments coals at 25 to 80°. The reagent is so selective for oxidizing aromatic rings and is so inert towards benzylic hydrogen that isopropylbenzene, tetralin, indan, and dihydrophenanthrene have their benzene ring(s) totally destroyed without any evidence of oxidation at the benzylic hydrogen. The fragments contain more and different structural information relative to conventional oxidations with Mn VII, Cr VI, HNO_3, and O_3. These latter selectively oxidize benzylic hydrogen. Products from 37 selected coals show that 9,10-dihydroanthracene and 9,10-dihydrophenanthrene units are prominent features in most bituminous coals in accord with Given's structure of coal. Their frequency accounts for the fact that no continuous fused ring structure or graphite structure exists. The only simple alkyl substituent is methyl.

Liquefaction (solvent refining) sharply increases the amount of arylmethyl and aromatic structure and causes the appearance of unsubstituted phenyl groups. Nitric acid degradations have been reinvestigated and are developed into a premier method for analyzing the amounts and lengths of linear alkane chains in coals. Generally the amounts of such chains represents 0 to 2% of the carbon in coal, but in one Utah coal they account for about 42% of the carbons.

33200 (DOE/ET/13381—T2) **Aliphatic components of coal. Quarterly report, March-June 1980.** Deno, N.C.; Cannon, C.; Curry, K.; Jones, A.D.; Potter, T.C.; Rakitsky, W.G.; Wagner, K.; Yevak, R. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Jun 1980. Contract AS01-78ET13381. 13p. NTIS, PC A02/MF A01.

Liquefaction of coal involves thermolysis of benzyl-oxygen and/or benzyl-benzyl bonds as the first step in the depolymerization. This view derives from NMR studies, studies with model compounds, and oxidative degradations with $Na_2Cr_2O_7$ and CF_3CO_3H-H_2SO_4. The best method for determining the amount of arylmethyl groups in coals is from the yield of acetic acid formed in oxidative degradation with CF_3CO_3H-H_2SO_4. The following observations and interpretations are made: a sharp increase in arylmethyl accompanies liquefaction in all five coals and in two coals studied earlier. This increase is the result of thermal cleavage to benzyl radicals and abstraction of hydrogen atoms by the benzyl radicals to form arylmethyl. All five coals give about the same percentage increase in arylmethyl after 90 mins of solvent refining, but not after 3 mins. This indicates that benzyl radicals form from more than one type of structure. Based on studies of model compounds, it is attractive to ascribe arylmethyl formation in 3 mins to cleavage of benzyl ethers and slower cleavage to bibenzyl structures. It might have been expected that the more arylmethyl, the more cleavage, and the more SRC. In fact the opposite is found. The conflict would be resolved if coal liquefaction depended more on certain critical cleavages and the conversion of a 3-dimensional polymer to a 1-dimensional polymer than on the total amount of cleavage and the extent of depolymerization. The amount of arylmethyl in the residue (3 min) is about the same as in the original coal. This indicates that arylmethyls do not play any role in liquefaction as expected. No higher homologs of acetic acid were observed indicating the absence of arylalkyls above methyl.

33201 (FE—2270-48) **Solvent refined coal (SRC) process operation of solvent refined coal pilot plant, Wilsonville, Alabama. Quarterly technical progress report, January-March 1979.** (Catalytic, Inc., Wilsonville, AL (USA)). Dec 1979. Contract EX-76-C-01-2270. 136p. NTIS, PC A07/MF A01.

Operating conditions and test results obtained at the six-ton-per-day Solvent Refined Coal (SRC) pilot plant in Wilsonville, Alabama are summarized. Two high-volatile bituminous coals were processed. The effects of dissolver volume (space rate), dissolver solids concentration, and feed gas rate on SRC yield and solvent hydrogen-donor quality were determined. A system for withdrawing a portion of the dissolver solids was utilized so that the effects of varying the solids concentration in the dissolver could be investigated. The effects of SRC process conditions and CSD operating conditions on SRC recovery were studied. Recovery of SRC in the Kerr-McGee Critical Solvent Deashing (CSD) unit improved when the dissolver volume was increased. Techniques for cleaning the United States Filter Corporation Vertical-Leaf Filter screens were investigated to provide a basis for redesign of the filter sluicing system. Laboratory-scale filter precoat tests were also made to determine the optimum screen type and mesh.

33202 Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide. Abdel-Baset, M.B.; Ratcliffe, C.T. (Allied Chemical Corp., Morristown, NJ). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 1, 1-7(1979). (CONF-800303—P4).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

All coal liquefaction processes involve thermal cracking of weak bonds in coal to form radical fragments which are stabilized by abstracting hydrogen atoms from a donor solvent. The activity of the hydrogen donor solvent is maintained by further hydrogenation of a recycled fraction. Thus, the costs of hydrogen comprise a major expense in any liquefaction process especially if pure H_2 is used. Hydrogen sulfide, a by-product of a negative value from the cleaning of natural gas, crude oil or coal, has been demonstrated to be a potential hydrogen source for a few chemical processes, such as selective reduction of NO/sub x/ to hydroxyl amine and reduction of nitroaromatics to amines. The effect of H_2S on coal liquefaction in the presence of hydrogen donor solvents and under H_2 atmosphere has been reported to increase the coal conversion to soluble products. Hydrogen sulfide in these latter cases was not the main source of hydrogen but acted as a promoter in the presence of hydrogen donors and elemental H_2. In order to utilize the inherent hydrogen value of hydrogen sulfide, we studied the effect of H_2S and CO on coal liquefaction in the absence of other hydrogen sources. A more detailed study of this chemistry was achieved by the use of coal tar, a material that contains many of the basic structural features of coal itself. The objective of this study has been to utilize low grade industrial hydrogen streams, particularly those produced via coal gasification which contain a large variety of impurities including H_2S, CO, CO_2, COS and NH_3. Utilization of the H_2S/CO from such dirty streams in the first stage of coal liquefaction will alleviate a number of expensive process steps in the cleaning of syngas.

33203 CO hydrogenation over rhodium foil and single crystal catalysts: correlations of catalyst activity, selectivity, and surface composition. Castner, D.G.; Blackadar, R.L.; Somorjai, G.A. (Univ. of California, Berkeley). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 27-42(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

CO hydrogenation at 6 atm over polycrystalline Rh foil and single crystal Rh (111) catalysts was investigated in a system where the surface structure and composition of the catalysts could be characterized both before and after the reaction. The reaction conditions (H_2:CO ratio, reaction temperature, and surface pretreatment) were systematically varied to determine the optimum conditions for formation of oxygenated hydrocarbons. Initially clean Rh catalysts showed no structure sensitivity, primarily produced methane (90 wt%) at an initial rate of 0.15 molecules $site^{-1}$ sec^{-1} at 300°C, and did not produce detectable amounts of oxygenated hydrocarbons. Preoxidation of the Rh catalysts (800 Torr O_2, 600°C, 30 min.) resulted in dramatically increased initial rates, a larger fraction of higher molecular weight hydrocarbons, some structure sensitivity, and formation of methanol, ethanol, and acetaldehyde. The different Arrhenius parameters over the clean and preoxidized foils indicate that the methanation mechanism is different on these two surfaces. Decreasing the reaction temperature of H_2:CO ratio increased the C_2H_4 to C_2H_6 ratio and shifted the product distribution towards higher molecular weight hydrocarbons.

33204 Effect of solvent quality on coal conversion. Curtis, C.W.; Guin, J.A.; Jeng, J.F.; Tarrer, A.R. (Auburn Univ., AL). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 185-194(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

One factor governing the success or failure of a coal liquefaction process is the ability of the process to generate and sustain an adequate amount of a sufficiently high quality recycle solvent for continuous operation. To insure continued operability of the plant and to recognize when solvent quality is declining it is useful to have a quantitative measure of the solvent's ability to liquefy some given coal under a prescribed set of operating conditions, i.e. the solvent quality. It is obvious that the solvent quality will depend to a high degree on the solvent composition - as determined by a variety of techniques - however, the solvent's performance will also vary with coal type and operating conditions. That is, the best solvent for coal A will not necessarily be the best solvent for coal B. Extension of this idea to temperature, pressure, residence time, etc. is obvious. Thus, when speaking of solvent quality, one must, of necessity refer to a prescribed set of conditions. In general, however, there will be some finite range of solvent parameters which are more beneficial for coal conversion for a rather wide variety of coals and processing conditions. The purpose of this study is to begin to define such a range of solvent parameters. While this set of parameters will not apply to all situations, it is hoped that they will allow a distinction to be made between a truly poor solvent and one which is satisfactory for coal liquefaction operations and perhaps some inclination as to the efficacy of a particular solvent under certain conditions.

33205 Products of liquefaction of lignite with synthesis gas by product slurry recycle. Farnum, B.W.; Knudson, C.L.; Koch, D.A. (Department of Energy, Grand Forks, ND). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 195-203(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Liquefaction of lignite is under study at the Grand Forks Energy Technology Center using a 5 lb coal per hour continuous processing unit (CPU) with various reactor configurations. The objectives of the experiment reported in this paper were (a) to test CPU operability under conditions of extensive product slurry recycle with fresh coal addition, (b) to produce a quantity of lined out lignite derived liquids for analytical characterization, and (c) to ascertain the function of reaction yields with the degree of line out or number of slurry passes. Separation of gas and liquid phases at 4000 psig and 300°C was carried out in the unit after the products exited the reactor. The gas phase was then cooled and depressurized producing a water layer, a high pressure volatile oil layer, and tail gases. Yields calculated on a moisture and mineral free coal basis were: C_1-C_4 hydrocarbons 19%, high pressure volatile oils 19%, vacuum distillate 36%, THF soluble vacuum bottoms 9%, and THF insoluble organic polymers 11%. Figure 2 depicts on an MAF coal basis a summation of the yields of the various product fractions. Ash concentration in the product stream paralleled the THF insoluble

values showing the same inclusion of inorganic fraction as coke formed in the reactor. Gas samples were analyzed by on-line gas chromatography. Effluent water samples were characterized by standard analytical methods for waste water and standard EPA methods. Figure 3 illustrates the approach to constant composition of the high pressure volatile oils collected during each pass. Low voltage low resolution mass spectrometry provided an indication of the organic oxygen compound type distribution of the high pressure volatile oils.

33206 Characterization of upgraded coal liquids. Hara, T. (Duquesne Univ., Pittsburgh, PA); Tewari, K.C.; Li, N.C.; Fu, Y.C. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 215-223(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The upgrading of coal liquids has become necessary in order to make acceptable fuels for home, transportation and industrial use. However, only a few studies have been reported on characterization and structural analysis of the different fractions obtained in the upgrading of coal-derived liquids. In this study, upgraded coal liquids from a blend of 30 weight percent of SRC I with 70 weight percent of SRC II, as well as from SRC II, have been studied by IR and NMR techniques. The variation of structural parameters of the upgraded liquids has been determined as a function of reaction temperature and contact time in the catalytic hydroprocesssing. The results indicate that along with the decrease in heteroatom contents, asphaltene content, aromatic content and a corresponding increase in aliphatic content, the hydrogen-bonded structure and phenolic OH content of the coal liquids drastically decrease with increase in contact time and temperature. The disappearance of phenolic OH in upgrading process follows a first-order kinetics but no such dependence was observed in case of acidic NH.

33207 Low temperature reaction path for coal liquefaction. Thomas, M.G.; Traeger, R.K. (Sandia Lab., Albuquerque, NM). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 224-230(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Onset of a solvent-coal reaction occurs in the 200-300°C temperature range. The temperature and extent of this reaction are dependent on the coal and solvent. In this initial reaction, THF soluble products increase but solvent is lost indicating formation of a THF soluble, coal-solvent reaction product. This reaction product, defined in the preasphaltene or asphaltol compounds, results in high viscosity products - possibly gels. Kinetic studies show the liquefaction mechanisms can be represented by parallel reactions of coal to preasphaltenes, asphaltenes, oils and gases. However, these data show coal itself does not undergo thermosolvolysis at temperatures to 300°C and free radical processes need not be invoked to explain the reactions observed in the 200-300°C range. The data do suggest an initial series reaction of Coal + Solvent → Preasphaltenes. The hydrogen donating capability of the solvent does not appear to be critical at this stage, but functional groups that can interact with the coal and cause swelling are important. This initial series reaction is also indicated in the short time, continuous reactor results, where the preasphaltene content rises along with a solvent loss early in the reaction; subsequent decrease in preasphaltene content is accompanied by an increase in oil and asphaltene concentrations. Preasphaltene chemistry needs further clarification. The extent, and possibly type, of coal-solvent interaction changes with temperature. Only about 30% THF conversion occurs at low temperatures with 80 to 95% conversion occurring over 400°C.

33208 Selectivity of coal minerals and SRC residue ashes for hydrodesulfurization in the SRC process. Garg, D.; Tarrer, A.R.; Curtis, C.W.; Lloyd, J.M.; Guin, J.A. (Auburn Univ., AL). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 231-242(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Hydrogen generation for SRC processing is a major operational cost, making short reaction times with minimum hydrogenation severity desirable. The overall objective of this study is to develop a methodology for using mineral additives to increase the rate of desulfurization during coal liquefaction. Some iron containing minerals, including the ash of SRC residue, have been shown to act as in situ sulfur scavengers. The addition of such minerals to the dissolver feed may allow sulfur removal requirements to be met with shorter reaction times and consequent lower hydrogen consumption. The role of mineral additives in coal liquefaction processing is to increase desulfurization with minimal but sufficient hydrogenation. Selectivity is a measure used to rate the effectiveness of the different mineral additives studied. By definition, selectivity is the ratio of the amount of sulfur removal to the amount of hydrogen consumed for a given reaction time. In previous studies, the effects of relatively large amounts of mineral additives on reaction rates have been examined in order to clearly delineate the effects of the additives. However, in actual application, such large amounts would be prohibitive due to the associated material handling difficulties. Therefore, one of the major objectives of this work is to demonstrate that only small, easily processed, amounts of mineral additives are required for effective sulfur scavenging, provided that the iron contained in the additives is in a form available for reaction and is present in stoichiometric amounts.

33209 Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal. Zielke, C.W.; Rosenhoover, W.A.; Struck, R.T. (Conoco Coal Development Co., Library, PA). Contract EX-76-C-01-1743. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 279-290(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

It has been demonstrated in batch and continuous bench-scale units that molten zinc chloride is a superior catalyst for liquefaction of coal, coal extract or other heavy hydrocarbons. High quality gasoline of 90 to 92 Research Octane Number is produced in high yield in a single hydrocracking step. Large amounts of zinc chloride are used as the catalyst for high activity, i.e., usually 1 gm of $ZnCl_2$ per gm of coal or extract feed. From 1 to 2 parts by weight of product catalyst is generated during the hydrocracking process depending on the $ZnCl_2$/feed ratio. This product catalyst is contaminated with zinc sulfide, ammonia or ammonium chloride complexed with zinc chloride (formed by the catalyst partially reacting with the sulfur and nitrogen in the feed during the hydrocracking step), carbonaceous residue that cannot be distilled out of the melt, and coal ash, when coal is the feed to the hydrocracking process. To keep the catalyst active, these impurities must be removed in a regeneration process in which the catalyst is converted back to essentially pure zinc chloride. The regeneration is accomplished by burning out the impurities in a combustor containing a fluidized bed of inert silica sand. Hydrogen chloride gas is added to the feed air to convert ZnO to $ZnCl_2$ and to prevent formation of ZnO by hydrolysis of zinc chloride in the combustor. Continuous regeneration of this coal-ash-contaminated spent melt from direct hydrocracking of coal and efficient zinc recovery therefrom has now been demonstrated for the first time. In this work zinc recovery was enhanced by introducing a secondary zinc recovery step in which zinc, retained in the coal ash rejected in the primary regeneration step, is largely recovered. This paper presents some of the results of this regeneration work with natural spent melt from direct coal hydrocracking.

PYROLYSIS AND CRACKING

33210 (BNL—51172) Flash hydropyrolysis of coal. Quarterly report No. 10, July 1-September 30, 1979. Steinberg, M.; Fallon, P.; Bhatt, B.L. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 100p. NTIS, PC A06/MF A01.

The parametric study of New Mexico sub-bituminous coal is completed except for a few experiments that may be found necessary when the data is correlated. This coal has been found to be considerably more reactive than the lignite previously studied, particularly at 500 psi where the gaseous yields were approximately twice that of the lignite (35% vs 17%) and liquids two to four times greater (10% vs 2.6 to 4.6%). The relationship between the yield of gaseous hydrocarbons from sub-bituminous coal at 900°C and the hydrogen partial pressure is not as linear as originally thought. At pressures below 1000 psi, there is an absolute increase of 3.75% per 100 psi increase in hydrogen partial pressure while above 1000 psi, the value is reduced to 2.2% per 100 psi. Neither the reduction in particle size to less than 50 microns nor the addition of Na_2CO_3 showed any significant change in yield obtained with the sub-bituminous coal at 900°C and 1000 psi. The experimental equipment has been modified and tested to allow steam to be injected into the feed gas. All the data from experiments using North Dakota lignite in which the H_2/coal ratio was approximately 1 has been correlated to produce one set of pre-exponential factors and activation energies for the reaction rate equations for all the hydrocarbon products. The activation energy for the initial products formation was calculated at 42,700 cal/mole with an estimated error of 80 cal/mole and the overall correlation coefficient was 0.83.

33211 Rates of light gas production by devolatilization of coals and lignite. Weimer, R.F.; Ngan, D.Y. (Air Products and Chemicals, Inc., Allentown, PA). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 129-140(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The kinetics of coal pyrolysis are important in many coal conversion processes which operate under conditions of relatively moderate temperatures (400° to 1000°C) and having anticipated coal residence times in the region of pyrolysis temperatures of between 10^{-1} and 10^4 seconds - a range of five orders of magnitude. Although many models have been postulated for coal devolatilization, Howard and his co-workers have shown that the use of a statistical distribution of activation energies can provide valuable insight into the

overall or global kinetics of the [pyrolysis] process, particularly with regard to explaining the effects of heating rate. They therefore state that, For a designer seeking a correlation of devolatilization yields, [the distributed activation energy model] combined with description of secondary reactions is presently the best recommendation. Ciuryla et al. have since shown that the parameters (mean activation energy, standard deviation of the energy distribution, and total potential volatilization) obtained by fitting total weight loss data obtained at heating rates of 40 and 160°C/min, for a Montana lignite and a Pittsburgh Seam bituminous coal, are close to the values reported by Anthony and Howard for the same coals at heating rates of 100 to 10,000°C/sec. The distributed activation energy model has not previously been applied to data for the yields of individual molecular species from coal pyrolysis. It has normally been assumed (with good results for data obtained over a narrow range of heating rates) that the yields of individual species can be modelled by a small set of individual reactions representing the major mechanisms for their production. However, it has been recognized that the parameters obtained from such models are only effective values which may have no fundamental significance.

33212 Thermal decomposition of aromatic substances. Miller, R.E.; Stein, S.E. (West Virginia Univ., Morgantown). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 271-277(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Based on experimental evidence in non-coal systems, and free radical thermochemical kinetics, certain specific features of coal conversion chemistry may be suggested: (1) The first covalent bonds to homolytically cleave upon heating coal are those that generate two resonance stabilized radicals (e.g., benzyl radicals). In fact, under normal liquefaction conditions ($\sim <$ 450°C) such bonds will be virtually the only bonds to break in this manner. Other reaction pathways may generate more reactive organic free radicals, however, these can be expected to abstract benzylic H-atoms, thereby producing resonance stabilized radicals. Hence, to a large extent, the free radical chemistry of coal is determined by the chemistry of resonance stabilized radicals. (2) Modes of bond rupture other than simple bond cleavage may be very significant in coal reaction. Two well known free radical pathways, β-bond scission and free radical displacement occur in 12DPE (and many other) pyrolyses. (3) In view of the relatively high temperatures and free radical concentrations in coal conversion, it might be surmised that free radical isomerizations take place under coal conversion conditions which are not observed in conventional solution phase free radical experiments. (4) The unique ability of tetralin and related compounds to act as effective donor solvents cannot be explained simply by its rate of reaction with free radicals. Two other factors concerning high temperature, free radical reactions of tetralin may help explain its special solvent properties.

BY-PRODUCTS

33213 Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens. Schaefer, H.G.; Vogts, A. US Patent 4,116,811. 26 Sep 1978. Filed date 4 Feb 1977. 8p.

Organic compounds containing active-hydrogen are separated from heterogeneous mixtures of organic compounds, such as tar, which also contain organic compounds without active hydrogen. The without method involves preferential conversion of the active hydrogen compounds to soluble compounds by reaction with a reagent which is an alkene oxide or ethyleneimine, introducing a solvent for the soluble compounds whereby two phases are formed, and then separating the phases.

PROPERTIES

REFER ALSO TO CITATION(S) 33199, 33200, 33206, 33587

33214 (CONF-800814—9) **Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids.** Hewitt, J.D.; Rodgers, B.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Coal liquids are a potpourri of organic molecules and inorganic particles; they cannot be considered as a single entity because of variations in coals and processing conditions during conversion to liquids. A method of solubility class fractionation originally developed for petroleum asphalts was adapted to coal liquids. The component classes - asphaltols, asphaltenes, resins, and oils - were separated according to their solubilities in benzene, pentane, and propane. Important physical and thermodynamic properties (viscosity, density, dielectric constant, and conductivity) of these fractions were determined as a function of temperature. In many cases these are the only values currently available to other investigators and are much in demand. We observed that density was most affected by the solids, as expected; however, the dielectric constant was most affected by the asphaltols, the viscosity by the resins (closely followed by the asphaltenes), and the conductivity by the resins. This led to the conclusion that the asphaltols contain the most polarizable material and the resins the most ionizable material. The conductivity remaining after all these materials were removed (10^{-9} mho/cm) and the dielectric constant (4.5) are still significantly higher than the corresponding values for most pure hydrocarbons and are important characteristics of these materials.

33215 (IS-T—923) Study of midwestern bituminous coal fly ash. Bruns, J.J. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 122p. NTIS, PC A06/MF A01.

Thesis.

A study of bituminous coal fly ash was undertaken in order to identify and characterize phases and structures microscopically observed. The observed phases were related to chemical and physical properties, including magnetic susceptibility, and to the formation of fly ash during the combustion process. Magnetic particles were found to consist of intergrown magnetite, hematite, and a glass phase. Aluminum, in the nonmagnetic fraction, was found to increase in amount as particle size decreased and the proportion of glass increased. The information provided by this study should be useful for other studies dealing with the recovery of metals from fly ash. It is recommended that the structure of fly ash particles be studied in detail in order to better understand the physical and chemical properties which influence the recovery of metals.

33216 Model for the isothermal plastometric behavior of coals. Lloyd, W.G. (Univ. of Kentucky, Lexington); Francis, H.E.; Yewell, M.R. Jr.; Kushida, R.O.; Sankur, V.D. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 128-137(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The plasticity of bituminous coals in the range 350 to 500°C is of critical importance in thermomechanical fluidization such as is required for coal pumping by heated screws and in hydrogenolysis in the absence of added solvent. The fact that the optimum reaction temperatures for three major current liquefaction technologies are nearly identical and are close to the fluidity maxima for many plastic coals suggests that the processes comprising coal melting are critically important to hydroliquefaction. More generally, coal plasticity is obviously involved in caking problems. The most widely used method of measuring coal plasticity was developed by Gieseler. It is often useful to study phenomena under isothermal conditions. Gieseler plastometry lends itself to such studies, since sample warmup time in the standard crucible (2 to 3 min.) is short in comparison with the usual melting/coking time scale (20 to 120 min.). The isothermal plastometric curves at 410 to 412°C obtained with the three coals described in Table 1 are shown in Figure 1. Extrusion pumping of coals in the plastic state entails substantially isothermal operations for residence times of a few minutes in the screw. Several coals, including those of the present study, have been extruded with no difficulty in JPL's 1.5-in. coal pump. Two coals which showed very little plasticity (less than 2 ddpm) were not extrudable. The isothermal plastometry profiles may prove to be a useful tool in predicting behavior in coal pumps. Recent evidence of the substantial effect of pressure upon observed plasticity indicates that this variable should be considered in future work.

33217 Chemical characterization of a hvb coal. Chung, K.E.; Anderson, L.L.; Wiser, W.H. (Univ. of Utah., Salt Lake City). CONTRACT E(49-18)-2006. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 243-250(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

A new characterization scheme for coal-derived liquids (CDL) has been devised based on the assumption that coal liquefaction is basically a depolymerization process. This scheme was instrumental in disclosing the following structural features of a hvb coal and its liquids: (1) A CDL (HVL-P), produced at 500°C wtih very short residence time, was almost completely depolymerized, i.e., essentially all linkages between aromatic clusters were broken, and consisted of three major component groups, A, B and C. The components in Group A had mostly one aromatic ring, those in Group B two to three fused aromatic rings and those in Group C four or more fused aromatic rings. (2) A solubilization product (SP-300), obtained in a reaction with NaOH/ethanol at 300°C, revealed that it was less depolymerized than HVL-P, but the size of average aromatic cluster was the same, 2.2 aromatic rings per cluster, as that of HVL-P. SP-300 consisted of three classes of average aromatic clusters having 1.3, 1.9 and 3.4 aromatic rings per cluster. (3) The clusters containing 1.3 and 1.9 aromatic rings per cluster are convertible to smaller species like Groups A and B in HVL-P, while the

larger clusters of 3.4 aromatic rings will become Group C in HVL-P. (4) The three groups of HVL-P were identified as the three major structural units of coal, and their distribution in the hvb coal was estimated from the examination of SP-300 and SP-320. Taking into account the heterogeneity of coal and its inaccessibility by analytical means, the present approach appears to be a practical, useful way to characterize the chemical structure of coal.

33218 Structural characteristics of vitrinites. Raj, S. (Ebasco Services Inc., New York, NY). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **24**: No. 3, 251-259(1979). (CONF-790917—P3).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

It is generally accepted that the various petrographic constituents of coals are derived largely from partly decayed organs of the higher plants and the chemical substances in them. Lignin, in particular, is thought to be an important part of the input to coalification processes both in preserved woody tissue and after the microbial action. The nature of the substances from which coals are derived are fairly well known. However, the chemical structures that they give rise to in coals are poorly understood. It was thought worthwhile to undertake a structural study of a set of vitrinite-rich coals (i.e., derived from woody tissue), using experimental approaches that would assist in evaluating the extent to which lignin structures are still recognizable after coalification. A reductive degradation method of Burges et. al., which has previously revealed the presence of lignin-derived phenols in the humic acids of soils, was adopted. Since coals of higher rank than lignites do not contain humic acids, humic-acid-like materials were generated in high yields (80 to 110 percent) by a mild oxidation using aqueous performic acid and the products subjected to the reductive degradation. Two peat samples, three lignites and thirty-eight subbituminous and bituminous coals were studied. The mixtures of phenols and phenolic acids obtained as trimethylsilyl ethers and esters were analyzed by gas chromatography/mass spectrometry.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 33175, 33177, 33215, 33597, 34098

33219 (DOE/ET/10533—9) **Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979.** Slonaker, J.F.; Buttermore, W.H.; Muter, R.B. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 30 May 1980. Contract AS01-77ET10533. 12p. NTIS, PC A02/MF A01.

Samples of feed coal, cleaned coal and refuse were obtained from a District 4 commercial preparation plant. This preparation plant supplies coal to the Solvent Refined Coal II (SRC II) pilot plant at Fort Lewis, Washington. Samples of the incoming feed coal, sized coal and vacuum bottoms waste material were obtained from the SRC II pilot plant at Fort Lewis, Washington. Research on the utilization of fluidized bed combustion by-products in the production of aerated concrete was completed. A financial report and milestone chart are presented.

33220 (FE—2496-42) **Biological treatment of Grand Forks Energy Technology Center slagging fixed-bed coal gasification process wastewater. Eleventh quarterly report, March 1979.** Luthy, R.G.; Sekel, D.J.; Tallon, J.T. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). 1979. Contract EX-76-S-01-2496. 120p. NTIS, PC A06/MF A01.

A wastewater biological treatability study was performed with effluent from the Grand Forks Energy Technology Center slagging fixed-bed coal gasification process. Bench scale air activated sludge reactors were used to determine minimum dilution requirements, maximum acceptable loadings, biological treatment kinetic coefficients, and other performance characteristics. It was found that ammonia stripped wastewater could be processed reliably at 33% strength at substrate removal rates less than approximately 0.6 mg COD removed/mg MLVSS-day. The wastewater when diluted to 33% strength contained highest reported concentration of organic contaminants in coal conversion effluents processed successfully by air activated sludge. The bacterial yield coefficient for treatment of 33% strength stripped wastewater was 0.29 COD basis, the endogenous respiration rate coefficient was 0.038 day^{-1}, COD basis. Raw wastewater with no ammonia removed could be processed at 40% strength. Nitrification was feasible with both stripped and unstripped wastewater. COD removal rates which impaired nitrification were dependent on ammonia loading, as nitrification could be sustained at higher values of substrate rate with unstripped wastewater than was observed with stripped wastewater.

33221 (IS—4744) **Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980.** Burnet, G.; Murtha, M.J. (Ames Lab., IA (USA)). May 1980. Contract W-7405-ENG-82. 44p. NTIS, PC A03/MF A01.

Research is focused on the development of methods for recovering minerals from power station fly ash, use of less costly reactants, improvement of energy efficiency, and development of uses for by-products. A research plan developed for collection of kinetic data for fly ash chlorination (HiChlor process) includes the use of different reactant gas mixtures contacting a small bed of fly ash in a new, vertical, down-flow reactor. In work on the lime-soda sinter process, research includes the common ion effect on the concentrations of dissolved alumina, silica, and calcium in the filtrates obtained from extraction of the sintered clinker. Experiments conducted to determine decomposition data for several samples of limestone scrubber sludge are reported. These experiments are the first step toward the possible use of the waste sludge as a replacement for limestone in the sintering process. A series of experiments conducted to evaluate the reactivity of commercial limestones showed that high grade limestone gave alumina recoveries equivalent to those obtained using reagent-grade $CaCO_3$ for nine sinter mixtures which were tested. Increased interest use of the iron-rich magnetic fly ash fraction as a heavy media material for coal beneficiation led to preparation of a research proposal to increase the scale of testing by use of commercial heavy media cyclones. The scope of the research is to be expanded to include a range of fly ashes and several commercial magnetite samples. Hydrochemical beneficiation tests of the iron-rich fraction to produce iron ore indicate that the limited dissolution of alumina from the ash is probably due to secondary precipitation reactions during digestion.

33222 (IS-M—289) **Power plant fly ash as a resource for alumina and cement.** Murtha, M.J.; Burnet, G. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 21p. (CONF-800802—15). NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

A sinter process has been developed to form soluble aluminate compounds from mixtures of fly ash, limestone, and soda ash. The aluminates are extracted, treated to remove silicates, and precipitated; the precipitate is calcined to metallurgical grade alumina. The extract residue shows promise as a raw material for the production of Portland cement. Process economics are presented, and the effects of alumina and silica contents of the fly ash, sintering temperatures and time, and sales credits for by-products are discussed.

33223 (IS-T—924) **High-temperature chlorination of coal fly ash.** Adelman, D.J. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 113p. NTIS, PC A06/MF A01.

Thesis.

Fly ash is being considered here as a source of aluminum and possibly titanium. The HiChlor process has been proposed and the steps necessary to extract and purify the metals from fly ash are outlined. A reduction-chlorination reaction is suggested as the step to remove the metals from fly ash. The fly ash is exposed at elevated temperatures to a reductant and chlorine, and volatile metal chlorides are produced. The purpose of the work reported here was to study this gas-solid reaction. Test conditions were specified, experiments conducted, and the results analyzed in an effort to decide what limited the reaction rates and the final fly ash conversions. With such information, operating conditions can be specified and equipment designed to improve the yields and efficiency of the reaction. The thermodynamics of the reactions of iron oxides, aluminium oxides, silicon oxides, and titanium oxides with the reductant and chlorine are considered. Leaching of the fly ash before reaction is desirable to remove calcium oxides (calcium compounds react preferentially with the chlorine). The reaction was followed for a two hour period; at this point the reaction nearly stopped with 80% recovery of alumina. Carbon monoxide is the primary reductant at 750°C and carbon at 900°C. (LTN)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33174, 33574, 34119, 34123, 34147

33224 (ANL/EMR—2(Vol.2B)) **Environmental control technology survey of selected US strip mining sites. Volume 2B. Alabama. Water quality impacts and overburden chemistry of Alabama study site.** Henricks, J.D.; Bogner, J.E.; Olsen, R.D.; Schubert, J.P.; Sobek, A.A.; Johnson, D.O. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 122p. NTIS, PC A06/MF A01.

As part of a program to examine the ability of existing control technologies to meet federal guidelines for the quality of aqueous effluents from coal mines, an intensive study of water, coal, and overburden chemistry was conducted at a surface coal mine in Alabama from May 1976 through July 1977. Sampling sites included the pit sump, a stream downgrade from the mine, the discharge from the water treatment facility, and a small stream outside the mine drainage. Water samples were collected every two weeks by Ar-

gonne subcontractors at the Alabama Geological Survey and analysed for the following parameters: specific conductance, pH, temperature, acidity, bicarbonate, carbonate, chloride, total dissolved solids, suspended solids, sulfate, and 20 metals. Analysis of the coal and overburden shows that no potential acid problem exists at this mine. Water quality is good in both streams sampled, and high levels of dissolved elements are found only in water collected from the pit sump. The mine effluent is in compliance with Office of Surface Mining water quality standards.

33225 (DOE/RA/33001—01(Vol.1)) **Refinery siting workbook: appendices A and B.** (Mittelhauser Corp., El Toro, CA (USA)). Jul 1980. Contract AC01-79RA33001. 531p. NTIS, PC A23/MF A01.

The objective of this effort is to develop and provide basic refinery-related information for use by state and local government officials as a basis for establishing responsible refinery siting requirements and policies consistent with the federal clean air and water standards and socio-economic concerns. The report will be organized into two volumes. The main text comprises the basic topics of physical concerns, regulatory requirements, and permitting activities, while the second volume includes the detailed appendix materials such as the applicable laws, and the necessary permits, as available and a glossary of pertinent terms. As a means to this objective, three refinery sizes, 200,000, 100,000 and 30,000 barrels per day crude charge will be discussed in technical terms. Process unit configuration will be presented which will maximize either gasoline or heating oil production with either sweet or sour crude oil feedstocks. The major issues affecting the socio-economic impact of siting the refinery in a given locale will be presented. These data will review the factors affecting the human environment and the issues that must be addressed to assess the impact that a refinery will have on a community. The key federal registrations which impact upon a refinery siting decision shall be reviewed. Summaries of these regulations and a simplified decision diagram for the air and water acts shall be presented to assist both government and refinery officials in understanding the scope of regulatory impact. All pertinent procedures required for refinery permitting shall be reviewed under the generalized headings of air, water, health and safety, land use, and miscellaneous permits. This categorization at the federal, state and local levels of government shall be used as a basis for establishing degrees of emphasis.

33226 (ORNL/TM—7249) **Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review.** Triegel, E.K. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01.

The proposed construction of coal conversion plants raises concerns regarding (1) the safe disposal of large quantities of solid waste generated by the technology and (2) the protection of the quality of groundwater. Soils are viewed as a means of attenuating contaminants, reducing the hazard of groundwater contamination, and also as a source of liner material for disposal areas. The purpose of this paper is to review the current literature to (1) identify those elements most likely to remain mobile in soils and (2) assess the relative importance of various soil properties in attenuating pollutants. Soil properties discussed in relationship to contaminant mobility are (1) surface area and the type and amount of clays present, (2) the amount of iron, aluminum, and manganese hydroxy oxides, (3) pH, (4) redox conditions, (5) organic matter content, and (6) the type and concentration of other ions or gases in the soil. The chemical behavior of the soil system is also affected by other factors that are dependent on the specific site and process. However, these are not discussed in detail in this paper. Several studies comparing the mobility of various trace elements and the behavior of different soil types are discussed. A more detailed analysis is given of the behavior of As, Ba, Cd, Cr, Cu, Co, Fe, Pb, Mn, Hg, Ni, polynuclear aromatic hydrocarbons, Se, Ag, and Zn. These species were chosen solely on the basis of primary or secondary drinking water standards and potential toxicity to aquatic life. The recommended standard, average background concentration in soils, and factors favoring mobility are given for each species.

33227 **Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Draft environmental statement.** Denver, CO; Geological Survey (1978). 260p. (NP—25054(Vol.1)).

State and Federal actions involve either approval or denial of permits for the reclamation plans, Big Sky mine, Peabody Coal Co., Rosebud County, Montana. The company proposes to expand the existing plant and loading facilities, haul and access roads, and the existing rail spur extending from Colstrip would be utilized. An estimted 30 million tons of low-sulfur coal would be removed from an area of about 894 acres over a period of about 8 years. A summary of adverse, unavoidable environmental impacts is: vegetation, soil, and overburden would be removed from 894 acres. It is uncertain that former vegetative productivity levels can be reestablished. There would be a loss in vegetative diversity for possibly several decades. Existing local aquifers would be destroyed. Wildlife habitat would be altered and wildlife diversity would be reduced. Dust emissions would increase significantly. 1264 acres of land would be temporarily removed from range, recreation, and wildlife uses during mining and reclamation. There may be an increase in surface water runoff, and a reduction in both surface and ground water quality. Administrative alternatives available to State and Federal agencies include: (a) deferring action, (b) preventing further development by suspending operations, cancelling the lease, or acquiring the lease, (c) rejecting the mine and reclamation plan or restricting development on the lease. Other options available include development of selected areas now under lease and approval of the proposed mining plan after modification. The mining and reclamation plan must be modified to meet criteria set forth in the Surface Mining Control and Reclamation Act of 1977 and the Strip and Underground Mine Reclamation Act of 1973 and other pertinent criteria.

33228 **Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Final environmental statement.** Denver, CO; Geological Survey (1978). 128p. (NP—25054(Vol.2)).

This section summarizes summarizes the mine plan and describes those revisions made in the original mine and reclamation plan described in Volume I, the draft statement. Most revisions were made in response to a June 5, 1978, letter from the Montana Department of h the Surface Mining Control and Reclamation Act of 1977 and the Montana Strip and Underground Mine Reclamation Act of 1973. Further revisions were submitted on July 11, 1979, as a deficiency letter (Appendix A, Volume II) was being mailed to the company from the Department of State Lands. This analysis reviews changes in the mine and reclamation plan as of July 11, 1979. The company is still in the process of modifying its plan to meet the requirements of the Montana Department of State Lands (DSL) and the Office of Surface Mining (OSM). Changes in response to agency requests would decrease the impacts from mining. Changes required by the regulatory agencies will be considered in an environmental assessment prior to agency approval.

MINING

REFER ALSO TO CITATION(S) 33224, 33227, 33228, 33684, 33685, 33586, 33706

33229 (DOE/EIA—0118(78)) **Bituminous coal and lignite production and mine operations-1978.** Boykins, C. (Department of Energy, Washington, DC (USA). Energy Information Administration). 16 Jun 1980. 90p. NTIS, PC A05/MF A01.

In 1978 bituminous coal and lignite US production totaled 665.1 million tons, a decline of about 3.8 percent from the alltime high of 691.3 million tons in 1977. The drop in production in 1978 was largely the result of the coal miners' strike that began December 6, 1977 and continued until March 25, 1978. Production from underground mines in 1978 totaled 242.2 million tons, down 8.9 percent from 266.0 million tons the previous year. Production from surface mines decreased to 423.0 million tons, 0.6 percent below the 425.4 million tons reported in 1977. The average price of coal (F.O.B. mines) rose 9.8 percent to $21.78 per ton from $19.82 per ton in 1977. At underground mines the average price was $30.94 per ton, up 9.5 percent from $28.25 per ton the previous year. At surface mines it increased 13.5 percent to $16.53 per ton from $14.56 per ton in 1977. The average number of miners employed rose 9.4 percent to 242.295 from 221,428 in 1977. Of the 665.1 million tons of bituminous coal and lignite produced in 1978, 557.1 million tons, or 83.8 percent, was prepared (mechanically cleaned, 224.7 million tons, 33.8 percent; crushed or screened only, 332 million tons, 50.0 percent) whereas the remaining 108.0 million tons, or 16 percent, was not processed. Railroads continued to transport most of the coal production, accounting for 402.6 million tons, or 60.5 percent of the total. Coal shipments by waterways totaled 58.9 million tons. Shipments by truck totaled 122.3 million tons, which included short-haul shipments to railroad and waterway loading facilities. The coal shipped directly to mine-mouth electric utilities amounted to 83.2 million tons. The coal shipped by slurry pipeline and used at the mines for various purposes totaled 12.5 million tons.

33230 (DOE/EIA—0119(77)) **Coal: Pennsylvania anthracite for the calendar year 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 13 Jun 1979. 35p. NTIS, PC A03/MF A01.

All anthracite consumed in the United States in 1977 came from production in northeastern Pennsylvania. A total of 5.9 million tons of anthracite was produced in 1977, a decrease of approximately 5% from production in 1976. Of the total production, 53% was produced at strip pits, 35% was recovered from culm banks, 11% was produced at underground mines, and the remainder, approximately 1%, was recovered from river dredging operations. The anthracite industry reported that there were 118 underground mines.

128 strip pits, 123 culm banks, 6 dredges, and 84 preparation plants in operation, either for all or part of calendar year 1977. The f.o.b. average commercial value at preparation plants was $44.74 per ton for Pea and larger sizes, and the average value of Buckwheat No. 1 and smaller sizes was $31.15 per ton. The average value for all sizes was $34.86. Productivity in anthracite mining in 1977 declined from the previous year. The average output per man day declined from 7.19 tons per man day in 1976 to 6.97 tons per man day for 1977. State and Federal Government public works programs in the environmental area continued throughout 1977. State and Federal Governments provide technical or financial assistance to municipalities and producing companies unable to cope with serious environmental problems.

33231 (DOE/ET/10023—T6) **Development of optimal terrace pit coal mining systems. Technical progress report, April 1980. Report No. TPR-80-4.** (Kaiser Engineers, Oakland, CA (USA)). 20 May 1980. Contract AC01-79ET10023. 4p. NTIS, PC A02/MF A01.

Work on optimizing terrace pit coal mines in various areas of the country and with different types of mining equipment is described. (LTN)

33232 (ORAU—168) **Coal mine labor productivity: mine-level data from Pike County, Kentucky, and other selected counties.** Gaston, R.J.; Baker, J.G.; Bishop, R.C.; Blair, L.M. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Tranining Div.). Jul 1980. Contract AC05-76OR00033. 51p. NTIS, PC A04/MF A01.

The mine-level examination of Pike County and other selected counties generally supports and nowhere contradicts the state-level and mine-level results obtained by Baker for Illinois and Ohio. In addition, the mine-level data from DOE's Coal Information System allows the examination of the influence of price per ton on individual mine productivity. In general, price had a significant negative effect, both with the pooled and cross-sectional data. The influence of mine turnover on productivity and other mine characteristics was also examined with the DOE Coal System data. The results gave virtually no support to the hypothesis that less efficient mines entering in a period of high prices contributed to depressed average labor productivity.

TRANSPORT AND HANDLING

33233 (PNL—3468) **Separate effects test stand for obtaining hydrotransport data.** Allen, C.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 25p. NTIS, PC A02/MF A01.

Based on earlier hydrotransport research by English and Russian researchers, a special test stand has been designed and constructed to obtain data to determine hydraulic drag, pipe wear, and comminution of particles. These data are intended for design and separate-effects operating information. This information will be used to supplement data developed by the Hydrotransport Research Facility located at the Pittsburgh Mining Operations, Pittsburgh, Pennsylvania. This report describes the equipment as designed, explains how the hydraulic drag is calculated using test-stand data, and presents some preliminary tests results using water. Tests using water are continuing to further substantiate the system and later, tests will be started using slurries.

33234 **Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81.** Baumel, C.P.; Drinka, T.P.; Miller, J.J. Ames, IA; Iowa State University (Oct 1978). 59p. (NP—25029).

Iowa coal users consumed approximately 7.9 million tons of coal in 1976. Consumption of coal in Iowa is expected to climb to about 16.1 million tons by 1980. Only 540,000 tons of Iowa coal were mined in 1976. Iowa coal production continues to decline in a period of increasing demand. Several reasons are advanced to explain this decline. The main goal of this study was to evaluate alternative Iowa coal transportation and distribution systems to determine which systems could improve the competitive position of Iowa coal relative to out-of-state coal. Possible improvements in coal transportation include larger shipments such as 15- and 20-car rail shipments, alternative types of trucks and truck weight limits, and intermodal combinations of rail and truck. A mathematical programming model was used to evaluate alternative coal transportation, coal beneficiation, and coal handling systems. The objective of the analysis was to find the minimum-cost method of transporting and distributing coal to supply Iowa's projected 1980 coal consumption and, at the same time, meet the sulfur dioxide emission standards and constraints on Iowa mining capacity. The model includes six possible modes of coal transport. These include truck, barge, single-car rail, 15-car rail, 50-car rail, and 100-car unit train. Simplified conclusions are: with single rail car rates, surface mining and beneficiation of Iowa coal may increase in 1980 by a factor of 4 to about 2,000,000 tons per year. With unit train rates to the largest users, the increase is less (a little more than twice 1976 production) due to the lower transport costs on the longer unit train runs for out of state coal. There are uncertainties in these figures (which are given) and certain qualifications (essentially recommendations for study of other factors). Typically, trucks have a cost advantage over single-car rates up to 140 miles. (LTN)

COMBUSTION

REFER ALSO TO CITATION(S) 34033, 34063, 34064, 34065

33235 (ANL/CEN/FE—80-5) **Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980.** Johnson, I.; Swift, W.M.; Lee, S.H.D. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01.

In the application of pressurized fluidized-bed combustion (PFBC) to the generation of electricity, hot corrosion of the gas turbine (downstream from the combustor) by alkali metal compounds is a possible problem. The objective of this investigation is to develop a method for the removal of the gaseous alkali metal compounds from the high-pressure high-temperature gas from a PFBC before the gas enters the gas turbine. The use of a granular bed filter, with either diatomaceous earth or activated bauxite as the bed material, is under study. A sectioned-bed technique is under development for the measurement of vapor breakthrough. The magnitude of the pressure drop across the bed is under investigation.

33236 (ANL/CEN/FE—80-6) **Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980.** Johnson, I.; Swift, W.M.; Lee, S.H.D.; Boyd, W.A. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01.

In the application of pressurized fluidized-bed combustors (PFBC) to the generation of electricity, hot corrosion of gas turbine components by alkali metal compounds is a potential problem. The objective of this investigation is to develop a method for removing these gaseous alkali metal compounds from the high-pressure high-temperature gas from a PFBC before the gas enters the gas turbine. A granular-bed filter, using either diatomaceous earth or activated bauxite as the bed material, is the concept currently being studied. Results are presented for the testing of diatomaceous earth for alkali vapor sorption at 800°C and 9-atm pressure, using a simulated flue gas. Activated bauxite sorbent can be regenerated by leaching with water, and the kinetics of the leaching is under study.

33237 (CONF-800428—7) **Atmospheric Fluidized Bed Combustion testing of North Dakota lignite.** Goblirsch, G.; Vander Molen, R.H.; Wilson, K.; Hajicek, D. (Combustion Power Co., Inc., Menlo Park, CA (USA); Department of Energy, Grand Forks, ND (USA). Grand Forks Energy Technology Center). May 1980. Contract AC03-78ET12297. 15p. NTIS, PC A02/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The sulfur retention by the inherent alkali, and added limestone sorbent, perform about the same and are reasonably predictable within a range of about +-10% retention by application of alkali to sulfur ratio. Temperature has a substantial effect on the retention of sulfur by the inherent alkali or limestone. The temperature effect is not yet fully understood but it appears to be different for different coals and operational conditions. The emission of SO_2 from the fluid bed burning the Beulah lignite sample used for these tests can be controlled to meet or better the current emission standards. The injection of limestone to an alkali-to-sulfur molar ratio of 1.5 to 1, should lower the SO_2 emissions below the current requirement of 0.6 lb $SO_2/10^6$ Btu to 0.4 lb $SO_2/10^6$ Btu, a safe 33% below the standard. Agglomeration of bed material, and consequent loss of fluidization quality can be a problem when burning high sodium lignite in a silica bed. There appears, however, to be several ways of controlling the problem including the injection of calcium compounds, and careful control of operating conditions. The heat transfer coefficients measured in the CPC and GFETC tests are comparable to data obtained by other researchers, and agree reasonably well with empirical conditions. The NO/sub x/ emissions measured in all of the tests on Beulah lignite are below the current New Source Performance Standard of 0.5 lb $NO_2/10^6$ Btu input. Combustion efficiencies for the Beulah lignite are generally quite high when ash recycle is being used. Efficiencies in the range of 98% to 99%+ have been measured in all tests using this fuel.

33238 (EPRI-CS—1465) **Technical planning study: Pressurized Fluidized-Bed Combustion. Final report.** Roberts, R. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. 200p. NTIS, PC A09/MF A01.

This project was initiated in 1978 to assist EPRI staff in the initial planning of the Pressurized Fluidized-Bed Combustion (PFBC) subprogram. PFBC is one of several advanced options being

considered by the utilities for the purpose of utilizing coal in a more efficient manner than conventional pulverized-coal power plants. PFBC, which utilizes a pressure recovery turbine operating on a high-temperature (1000-1750°F), high-pressure (up to 16 atmospheres) flue gas is potentially attractive due to low SO/sub x/ and NO/sub x/ emissions and reduced water consumption. Also, if development issues are resolved, it potentially offers the simplest flow sheet of the high-efficiency advanced coal options. The purpose of this technical planning study was to identify the current status of PFBC research and development through the assessment of past and ongoing projects. Also, specific areas where additional research and development is required were to be identified. As well as providing a useful catalogue of past PFBC research, this report recommends the achievement of 14 key technology milestones before proceeding with a prototype demonstration of a commercial PFBC configuration. The selection of a hot gas cleanup system/gas turbine combination which provides the reliability required for a commercial utility plant remains the most important of the technology issues to be resolved through further development and testing. EPRI also initiated projects during 1978 to immediately address 4 key PFBC development issues: improve hot gas cleanup systems; increase turbine reliability; confirm reliability of heat exchange materials and conventional cyclones; and select optimum cycle and projected economics.

33239 (ORNL/TM—7377) **Cold slumping characteristics of a fluidized bed.** Lackey, M.E. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

Cold slumping tests were performed on a 4 x 4 Plexiglas model of the TVA 20-MW atmospheric fluidized bed combustion pilot plant. The tests were conducted to determine mixing between the active and slumped sections, fluidizing air bypass through the slumped section, elutriation from the fluidized section, and maximum buildup in the slumped section. With an 18-in. bed depth and a mean particle size of 370 μm, the average superficial velocity in the slumped section was approximately one-half of the minimum fluidizing velocity. The maximum buildup in the slumped section was ~ 35% of the bed static depth. The elutriation from the active bed resulted in a decrease of ~ 20% in the static bed height. The potential oxidizing-reducing condition at the interface of the slumped and fluidized bed sections as well as the chance of crusting the slumped section may be prevented by supplying air to the windboxes of the slumped sections. It is recommended that this approach be allowed for in the design of the pilot plant by the installation of the equipment required to meter the air flow to the windbox of each bed section that can be slumped. The approximate air-metering range should be from 25 to 110% of air required for minimum fluidization of the section.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 33176, 33229, 33230

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 34198, 34201

33240 (CONF-800814—13) **Use of a fiber-optics skin contamination monitor in the workplace.** Vo-Dinh, T.; Gammage, R.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

This paper describes the luminoscope, a simple laboratory-constructed, portable luminescence detector designed specifically for monitoring occupational skin contamination. The instrument design is based upon a fiberoptics waveguide. The instrument is suitable for detecting trace amounts of various coal tars and has recently been field tested at a coal conversion facility.

REGULATIONS

33241 (DOE/ET/12276—T1) **Panel reports of the first session of the workshop on coal for California.** (Jet Propulsion Lab., Pasadena, CA (USA)). May 1980. Contract AA01-78ET12276. 163p. NTIS, PC A08/MF A01.

The panel reports are the result of a five-day workshop held at the Pajaro Dunes Conference Center, Watsonville, California, October 1-6, 1978. The workshop was conducted by JPL, under the sponsorship of the US Department of Energy and the California Energy Commission. The purpose of the exercise was to assay the opinions of a broad range of groups in order to identify what people perceive to be the problems associated with increased coal use in California. Representatives from utilities, industry, mining companies, citizens groups, and the academic community were divided into seven panels, each of which prepared a report. Representatives of government agencies attended as observers. The panels examined end-uses of coal in California, mine-mouth conversion, advanced concepts and use of Alaskan coal, environmental effects, public acceptance, finance, and legislation and regulation.

PETROLEUM

REFER ALSO TO CITATION(S) 33171

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 33557

33242 (JPRS—75887, pp 10-24) **Characteristics of evolution of petroleum in Huanghua Depression.** Benshan, W.; Dehan, L.; Lijie, Z.; Zhaoping, L.; Wenlan, S. 16 Jun 1980. Translated from Shiyou Xuebao; 1: No. 1, 43-51(Jan 1980). NTIS.

In China report: science and technology, No. 40.

In recent years, as the cheese base theory of petroleum genesis developed, people have given a lot of attention to the evolution of petroleum (i.e., the genesis, development, oxidation, and alteration). Various scholars have conducted broad studies in different region. They have made great progress in the classification of the evolutionary stages of petroleum, determination of the critical temperatures of each stage and changes in the characteristics of composition of crude oils, and they have preliminarily established a model of the evolution of petroleum. But the above studies mostly emphasize environments of marine facies and delta facies in the genesis of petroleum. Few have studied the genesis of petroleum in a basin of land facies characteristic of our nation. This article is an attempt to explore the evolutionary characteristic of petroleum in the Huanghua Depression of the Bay of Bohai Basin on the basis of an anatomy of the typical sections and in combination with artificial simulation experiments.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 33499, 33500

33243 (DOE/BC/20001—6) **Tertiary oil recovery processes. Annual report, October 1978-September 1979.** Bourrel, M.; Baviere, M.; Fernandez, M.; Koukounis, C.; Lim, H.; Gracia, A.; Nunn, C.; Scamehorn, J.; Wade, W.H.; Schechter, R.S. (Texas Univ., Austin (USA)). Aug 1980. Contract AC19-79BC20001. 212p. NTIS, PC A10/MF A01.

The following were studied: phase behavior of oil--water--electrolyte--surfactant systems, adsorption of surfactants, emulsion stability, effects of alcohols on microemulsion composition, and correlation for phase behavior of nonionic surfactants. (DLC)

33244 (DOE/BC/20009—8) **Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979.** (Pennsylvania State Univ., University Park (USA)). Oct 1980. Contract AS19-78BC20009. 276p. NTIS, PC A13/MF A01.

This research program covers a number of facets involved with enhanced oil recovery by chemical flooding. Each facet is covered in a separate section of this report. This report including the appendixes presents the results of a systematic study of factors influencing the flow of polymer solutions in porous media. Effects of inertia, shear-thinning viscosity, viscoelasticity, and molecule-wall interactions on the flow in porous media are demonstrated by correlations of the appropriate dimensionless parameters. Packed beds of glass beads with different particle sizes are used. The polymer solutions investigated include sodium carboxymethyl cellulose (CMC), hydroxyethyl cellulose (HEC), xanthan gum (XG), sodium cellulose sulfate ester (CSE), polyethylene oxide (PEO), and partially hydrolyzed polyacrylamide (PAM). Fluid property variables in the dimensional analysis include power-law parameters, relaxation time, and molecular size of the polymer solution. Power-law parameters and relaxation time of the solutions were determined from a cone-and-plate steady-shearing experiment. The hydrodynamic size of the polymer molecules is characterized by coupling intrinsic viscosity measurements with gel permeation chromatography.

33245 (DOE/ET/12065—26) **Enhanced oil recovery by improved waterflooding. Second annual report.** (Energy Resources Co.,

Inc., Cambridge, MA (USA)). Aug 1980. Contract AC01-77ET12065. 173p. NTIS, PC A08/MF A01.

Energy Resources Co. Inc. is currently operating a pilot polymer improved waterflood of the Storms Pool, a sandstone reservoir in the Illinois basin. During the second year of the project, progress was made in the laboratory work, field preparation, and computer simulation. Tasks II, VII, and IX, polymer selection, workovers, and model building were completed during 1979. The polymer selected is a xanthan type polysaccharide polymer. Other laboratory work included preliminary testing of biocides and oxygen scavengers. Development of the pilot area continued with the completion of the well workovers and the design and initiation of construction of the injection facility. Preliminary simulation was begun.

33246 (DOE/SF/01424—26) **Big Muddy Field low tension flood demonstration project. Second annual report, April 1979-March 1980.** Ogren, D.J. (Conoco, Inc., Casper, WY (USA)). Aug 1980. Contract AC03-78SF01424. 80p. NTIS, PC A05/MF A01.

Construction of the injection plant is complete for the brine preflush phase, and check-out of the water injection facilities for the preflush phase is nearly completed. Producing facilities have been completed and tested. The residual oil saturation after waterflooding was determined in Well RBW 92 to be 32%. The pore volume of the demonstration area was calculated to be 8.55 million barrels. Several energy-saving techniques were used in the project.

33247 (LBL—11086) **Random choice method for calculating fluid displacement in a porous medium.** Albright, N.; Anderson, C.; Concus, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 13p. (CONF-800695—1). NTIS, PC A02/MF A01.

From 1. BAIL conference; Dublin, Ireland (3 Jun 1980).

Multiphase fluid displacement in a porous medium gives rise naturally to the occurrence of steep fronts, for example between different fluids or between regions of differing chemical concentrations. Such fronts pose substantial difficulty for most numerical methods. However, the recently developed random choice numerical method has been found capable of following effectively even perfectly sharp fronts. An application to the calculation of immiscible displacement in a petroleum reservoir is discussed, including the effects of capillary pressure and gravity. Previous work with W. Proskurowski has considered the limiting hyperbolic case of zero capillary pressure with gravity neglected. Numerical results of our current work for solving a model problem of two-phase displacement in two dimensions indicate that the effects of the additional possible interactions of shock and expansion waves permitted by the inclusion of gravity can be handled efficiently within the framework of the random choice method.

33248 (SAND—80-1019) **FY 80 heavy oil program. Second quarterly report, April 1980.** Wayland, J.R.; Fox, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01.

The research and development efforts in support of the heavy oil program reservoir access and alternate extraction activities that were initiated last quarter have been continued and expanded. The development of a short course on the utilization of specialized drilling technology to heavy oil sands has been investigated. The steam quality sampler is undergoing laboratory testing. A special report on possible application of sand control methods to heavy oil steam injection tests has been prepared. The first stage of the analysis of R.F. and microwave heating has been completed. The results of a series of laboratory experiments on in situ hydrogenation are presented.

33249 (SAND—80-1292) **Application of statistical estimation theory to the determination of porosity and residual oil saturation.** Lyle, W.D.; Eisenhawer, S.W. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 63p. NTIS, PC A04/MF A01.

Several distinct techniques exist for obtaining independent measurements of porosity and residual oil saturation. This paper derives an algorithm for combining any number of such independent measurements of either of these parameters into a single measurement or estimate. The estimate so obtained is shown to have a deviation from the true parameter value that is less than the deviation of the best of the individual estimates. In deriving this estimate an analysis is made of the errors associated with porosity measurements obtained from core analysis, formation density logs, and neutron logs, and errors associated with pulsed neutron capture logs and nuclear magnetism logs for saturation measurements. This analysis yields the probability density functions of the errors in a general form that is applicable to a wider range of measurements than those considered in this paper. Finally, a complete statistical analysis is made of the errors associated with saturation measurements using resistivity logs and the probability density function of the measurements is obtained. The mean and variance of these measurements are expressed in terms of parabolic cylinder functions and close approximations to the exact mean and variance are obtained.

33250 Process and system for recovering hydrocarbons from underground formations. Rose, L.C.; Hamrick, J.T. (to World Energy Systems). US Patent 4,159,743. 3 Jul 1979. Filed date 13 Mar 1978. 14p.

A gas generator for use in a borehole for generating steam and other hot gases for use in recovering hydrocarbons or other fluids from underground formations is described. The gas generator comprises a housing forming a chamber with a combustion zone at one end and a restricted outlet at the other end. A second zone is located downstream of the combustion zone and a gas and water mixing zone is located between the second zone and the restricted outlet. The generator has a cooling annulus surrounding the chamber with passages leading from the annulus to the gas and water mixing zones. Methane is burned in the combustion zone with just enough oxygen to maintain the flame temperature below the decomposition temperature of methane to convert substantially all of the carbon to carbon monoxide and to form hydrogen. In the second zone, the carbon monoxide and hydrogen are burned with an additional supply of oxygen to increase the temperature and to form carbon dioxide and hydrogen. Water is supplied to the annulus for cooling purposes and for injection into the gas and water mixing zone for cooling the gases therein and for forming steam whereby hydrogen, steam, and carbon dioxide are injected from the restricted outlet. In a second embodiment, hydrogen may be used as the fuel. The hydrogen is burned with just enough oxygen in the first zone to maintain a flame temperature of 1600 to 2000 degrees F. 14 figures.

PROCESSING

REFER ALSO TO CITATION(S) 33225, 33274, 33491, 33492, 33493

33251 Hydrocracking with catalyst modified by group IIA. O'Hara, M.J.; Johnson, R.W.; Hilfman, L. (to UOP Inc.). US Patent 4,179,356. 18 Dec 1979. Filed date 13 Nov 1978. 8p.

Disclosed is a hydrocracking catalyst comprising an alumina-zeolite support, a rare earth exchange metal component, at least one metal component selected from Group VIB or Group VIII and from about 0.1 to about 5 wt % of at least one component selected from Group IIA based on the weight of the finished catalyst.

33252 Selective hydrocracking process for middle distillate. O'Hara, M.J.; Johnson, R.W. (to UOP Inc.). US Patent 4,179,357. 18 Dec 1979. Filed date 27 Jul 1978. 8p.

A process is described for the selective production of middle distillate hydrocarbons from heavier hydrocarbon feed stocks utilizing a hydrocracking catalyst comprising an alumina-zeolite support, a rare earth exchange metal component and at least one metal component selected from Group VIB or Group VIII and having a nominal particle diameter of less tha 0.04 inches.

33253 Combination residual oil hydrodesulfurization and catalytic cracking process. Frayer, J.A.; Stauffer, H.C.; Yanik, S.J. (to Gulf Research and Development Co.). US Patent 4,179,354. 18 Dec 1979. Filed date 20 Oct 1977. 16p.

A multistage hydrodesulfurization operation is provided in which the proportion of 1050°F+ (566°C+) residual components in the cracking feedstock is diminished whereby the amount of 1050°F+ (566°C+) residuals vaporized per barrel of feedstock during the subsequent cracking step is increased. The present method provides an interdependent advantage in the hydrodesulfurization operation since it reduces hydrogen consumption during hydrodesulfurization. 5 figures.

33254 Cobalt-molybdenum-alumina desulfurization catalyst. Simpson, H.D. (to Union Oil Co. of California). US Patent 4,179,410. 18 Dec 1979. Filed date 3 Jan 1978. 8p.

Novel, high surface area cobalt-molybdenum-alumina desulfurization catalysts containing 20 to 30 weight-percent of MoO_3, and being free of X-ray-detectable cobalt molybdate crystallites, are disclosed. A preferred method of preparation involves first comulling boehmite alumina with aqueous ammonium molybdate solution, drying the resulting mixture, then comulling with a soluble cobalt salt and water, thereafter forming the resulting mixture into extrudates, and finally calcining the extrudates under controlled temperature conditions correlated with the molybdenum content of the catalyst so as to preserve adequate surface area and prevent the formation of large crystallites of cobalt molybdate.

33255 Hydrocarbon cracking catalyst. Gladrow, E.M.; Wheelock, K.S. (to Exxon Research and Engineering Co.). US Patent 4,179,409. 18 Dec 1979. Filed date 9 Nov 1977. 10p.

A perovskite is added to a conventional hydrocarbon cracking catalyst comprising a zeolite and an inorganic oxide gel matrix.

The perovskite is present in the catalyst in an amount up to about 10 weight percent based on the total catalyst.

33256 Process for aromatics extraction from a 300 to 430°F boiling range naphtha. Irani, C.A.; Kasegrande, S.S.; McHugh, D.J.; Leder, F. US Patent 4,179,362. 18 Dec 1979. Filed date 5 Jan 1978. 6p.

Petroleum fractions may be separated into aromatic rich and paraffinic-rich hydrocarbon streams by the use of methanol/water mixtures having at least 10% water by volume. The paraffinic-rich stream is recovered as raffinate and the aromatic-rich as extract. After the extraction step additional water is added to the extract and raffinate streams where it acts as an anti-solvent to effect separation of the hydrocarbon from the solvent. The water and methanol are then separated for example by flash distillation or by using super critical CO_2 as an extraction solvent. 2 figures.

33257 Sorbent regeneration in a process for removing sulfur-containing impurities from mineral oils. Michlmayr, M.J. (to Chevron Research Co.). US Patent 4,179,361. 18 Dec 1979. Filed date 13 Nov 1978. 8p.

Mineral oils containing minor or residual amounts of sulfur-containing impurities are upgraded by contact thereof with a cobalt oxide-supported sorbent under sulfur-sorbing conditions. The sorbent is regenerated by a set of sequential treatment steps.

33258 Hydrocarbon conversion with an acidic multimetallic catalytic composite. Flagg, J.F.; Antos, G.J. (to UOP Inc.). US Patent 4,179,360. 18 Dec 1979. Filed date 27 Jul 1978. 24p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with an acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum group component, a nickel component, a uranium component, and a halogen component with a porous carrier material. The platinum group, uranium, nickel, and halogen components are present in the multimetallic catalyst in amounts respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt % platinum group metal, about 0.1 to about 10 wt % uranium, about 0.05 to about 5 wt % nickel, and about 0.1 to about 3.5 wt % halogen. Moreover, these metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum group component is present therein in the elemental metallic state, substantially all of the catalytically available nickel component is present in the elemental metallic state or in a state which is reducible to the elemental metallic state under hydrocarbon conversion conditions, or in a mixture of these states, while substantially all of the uranium component is present in an oxidation state above that of the elemental metal. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low-octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the acidic multimetallic catalyst disclosed herein at reforming conditions.

33259 Hydrocarbon conversion with an acidic multimetallic catalytic composite. Hayes, J.C.; Pollitzer, E.L. (to UOP Inc.). US Patent 4,179,359. 18 Dec 1979. Filed date 12 Jul 1978. 24p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with an acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum or palladium component, an iridium component, a cobalt component, a Group IVA metallic component and a halogen component with a porous carrier material. The platinum or palladium iridium, cobalt, Group IVA metallic and halogen components are present in the multimetallic catalyst in amounts, respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt % platinum or palladium, about 0.01 to about 2 wt % iridium, about 0.05 to about 5 wt % cobalt, about 0.01 to about 5 wt % Group IVA metal and about 0.1 to about 3.5 wt % halogen. These metallic components are, moreover, uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum or palladium and iridium are present therein in the elemental metallic state, substantially all of the Group IVA metal is in a positive oxidation state and substantially all of the catalytically available cobalt component is present in the elemental metallic state or in a state which is reducible to the elemental metallic state under hydrocarbon conversion conditions or in a mixture of these states. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low-octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the acidic multimetallic catalyst disclosed herein at reforming conditions.

33260 Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix. Swift, H.E.; Stanulonis, J.J.; Reynolds, E.H. (to Gulf Research and Development Co.). US Patent 4,179,358. 18 Dec 1979. Filed date 8 Nov 1978. 12p.

In a process for cracking gasoline feedstock with superior relectivity to gasoline production and greater metals tolerance, the gasoline feedstock is brought into contact with a fluid cracking catalyst comprising a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix in which the matrix has outstanding thermal stability.

33261 Thermal cracking of gas oil to middle distillate. Chang, B.H. (to Exxon Research and Engineering Co.). US Patent 4,178,228. 11 Dec 1979. Filed date 7 Jun 1978. 6p.

A mild thermal cracking of gas oil in the absence of cracking catalysts and in the presence of added olefinic naphtha increases the yield of middle distillate. 2 figures.

33262 Process for the simultaneous production of aromatic hydrocarbons and isobutane. Johnson, J.A.; Touma, R.G. (to UOP Inc.). US Patent 4,178,230. 11 Dec 1979. Filed date 22 May 1978. 14p.

A hydrocarbon charge stock boiling below 500°F is converted into aromatic hydrocarbons and isobutane via a combination process involving catalytic reforming, hydrocracking and subsequent catalytic reforming without the immediate separation of the product effluent from the lead reformer and hydrocracking zone.

33263 Combination process for selected aromatic hydrocarbon production. Addison, G.E. (to UOP Inc.). US Patent 4,158,026. 12 Jun 1979. Filed date 13 Mar 1978. 14p.

Selected aromatic hydrocarbon concentrates - benzene, mixed xylenes, etc. - are produced by way of a combination process which involves catalytic reforming followed by hot flash separation of a portion of the reformed product and dealkylation of the resulting hot flash liquid phase in admixture with a second portion of the reformed product. Although the process affords flexibility respecting the precise aromatic concentrate produced, it is particularly directed toward the maximization of benzene from normally liquid naphtha hydrocarbons boiling up to about 425°F (218°C).

33264 Development of a simulated catalyst aging technique. Kriz, J.F.; Ternan, M. (Dept. of Energy, Mines and Resources, Ottawa, Ontario). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **25**: No. 2, 146-152(1979). (CONF-800303—P3).

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Under hydrocracking conditions, heavy oils produce deposits that accumulate on the catalyst surface. By poisoning and by hindering accessibility of the active sites, these deposits cause fouling of the catalyst. Material that is so deposited is either originally present in the feed, such as heavy metals and minerals, or is formed during hydrocracking, such as coke. Not all deposits deactivate the surface at the same rate. It was established by repeated regeneration that rapid fouling under typical bitumen hydrocracking conditions is caused primarily by coke formation. To obtain a longer-lasting formulation, catalyst development should therefore focus on types that resist coke formation. Such an effort would involve a systematic approach to catalyst production based on information obtained in aging tests. To determine the true aging characteristics, actual processing conditions must be maintained because they affect product formation and thereby also the process of deactivation. However, a serious disadvantage of aging tests under actual processing conditions is that they are slow and thus consume a great deal of time and manpower. The time involved becomes critical if aging characteristics are required for a large number of catalysts. It is the purpose of this report to describe a technique that simulates catalyst aging and provides preliminary information in a much shorter time.

MARKETING AND ECONOMICS

33265 (DOE/EIA—0117/78) Energy data report: world crude oil production annual 1978. (Department of Energy, Washington, DC (USA). Energy Information Administration). 12 Jun 1979. 3p. NTIS, PC A02/MF A01.

World crude oil production in 1978 totaled 22,158 million barrels, an increase of 258 million barrels above the 1977 level. Western Hemisphere production amounted to 5,396 million barrels, compared with 5 139 million barrels in 1977. The 257-million-barrel increase is attributed principally to the United States' North Slope of Alaska, Mexico, Argentina, Ecuador and Peru. Eastern Hemisphere crude oil production increased slightly, by 590,000 barrels. Largest decreases were in the Middle East and Africa; however, Norway, United Kingdom, Brunei, Malaysia, People's Republic of China and the USSR reported increases in production. Countries that produced more than a billion barrels of crude oil in 1978 ranked as follows: USSR, United States, Saudi Arabia, and Iran. All 1978 figures in this table are preliminary and subject to change.

33266 (DOE/PE/70076—T1) Competitive economics of United States and foreign refining. (Pace Co. Consultants and Engineers, Inc., Houston, TX (USA)). Dec 1979. Contract AC01-79PE70076. 137p. NTIS, PC A07/MF A01.

The existing Caribbean export refineries are at a competitive advantage relative to all US Gulf Coast refineries except the very large, high conversion facilities. The advantage ranges from a minimum of $0.45 per barrel to a maximum of $2.14 per barrel (1978 US dollars) in 1980 with US crude oil prices at world levels. The existing European export refineries are also at a competitive advantage relative to the hydroskimming and low conversion US Gulf Coast refineries. Higher crude oil and product transportation costs reduce the European export refinery's competitive advantage compared to its Caribbean counterpart. The Caribbean and Roggerdam refiner's competitive position would be significantly enhanced with the addition of conversion facilities to increase gasoline and distillate yields. The advantage in 1985 would increase to a maximum of $2.54 per barrel (1978 dollars). Higher crude oil and product transportation costs due to natural port limitations and the Jones Act are key factors determining the US Gulf Coast refiner's competitive position. These locational disadvantages in addition to US emission standards account for $1.42 and $0.94 barrel of the competitive advantage of the Caribbean and European export refineries, respectively. New US refineries are at an even greater disadvantage relative to foreign competition. Caribbean and Mexican locations are the most attractive for a new refinery. Mexico also has potentially cheap natural gas for refinery fuel. These factors give a new Mexican or Caribbean refinery about a $2.00 to $3.00 per barrel advantage relative to a US East or Gulf Coast location.

33267 (LA—8497-MS) **Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978.** Bruckner, L.A.; Thomas, G.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 44p. NTIS, PC A03/MF A01.

The 1978 Outer Continental Shelf Lands Act Amendments charged the government with promulgating new regulations concerning the leasing of offshore tracts for hydrocarbon development. Among the reasons for this charge were to increase competition, reduce front-end money, and stimulate production. We used box plots to provide profiles of the bidding and production data from the different historical leasing methodologies. These profiles can be used to provide insights into the present data and to allow comparison with results of the new regulations.

33268 (NP—24979) **Mineral oil statistics 1979 for the Federal Republic of Germany with comparative figures for January/December 1978.** (Bundesamt fuer Gewerbliche Wirtschaft, Hamburg (Germany, F.R.)). Feb 1980. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01.

Tables are given for: imports and exports of petroleum and natural gas; production of petroleum, natural gas, and petroleum gas in West Germany; petroleum processing; production of finished mineral oil products; losses, exports, and domestic sales of mineral oil products; production and losses of lubricants by types.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33557, 34123, 34204

33269 (DOE/EA—0061) **Environmental assessment: allocation of petroleum feedstock, Columbia LNG Corporation, Green Springs SNG Plant, Green Springs, Seneca County, Ohio.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Aug 1978. Contract AC01-77RG08753. 115p. NTIS, PC A06/MF A01.

DOE is considering an extended period allocation of liquid petroleum feedstocks for use in the production of SNG by Columbia Liquid Natural Gas (LNG) Corporation (Columbia LNG) in its Green Springs, Ohio, Gas Reforming Plant. The purpose of this report is to assess the degree to which the requested allocation, if granted, would constitute a major federal action that would significantly affect the quality of the human environment within the meaning of Section 102 (2) (c) of the National Environmental Policy Act of 1969 (NEPA). This environmental assessment (EA) will be used as a basis for determining whether an environmental impact statement (EIS) is required before the DOE makes a feedstock allocation decision or whether a negative determination is appropriate.

33270 (DOE/EV/06020—T3) **Control and extinguishment of LPG fires. Final report.** Johnson, D.W.; Martinsen, W.E.; Cavin, W.D.; Chilton, P.D.; Lawson, H.P.; Welker, J.R. (Applied Technology Corp., Norman, OK (USA)). Aug 1980. Contract AC05-78EV06020. 124p. NTIS, PC A06/MF A01.

Approximately 100 fire control and fire extinguishment tests were run on free-burning liquefied petroleum gases (LPG) pool fires from 25 ft^2 to 1600 ft^2 in area. The LPG was contained in concrete pits, and the pit floors were allowed to cool before the fires were ignited so that the burning rates were not influenced by boiloff from the warm floor. High expansion foam was used for fire control. The foam was applied from fixed generators located on the upwind side of the pit. Fires were controlled after foam application of less than a minute to about 10 minutes, depending on the application rate. Fires were extinguished with dry chemical agents applied through fixed piping systems with tankside nozzles and by manual application using hoselines and portable extinguishers. Fires could readily be extinguished in times ranging from a few seconds to about half a minute, depending on the application rate, system design, and ambient conditions. Additional tests were conducted in 1-ft^2 and 5-ft^2 pits to determine the boiloff rates for LPG spilled on concrete, a sand/soil mix, and polyurethane foam substrates. Burning rates for free-burning LPG pool fires from 1 ft^2 to 1600 ft^2 in area are also reported.

33271 (JPRS—75887, pp 25-36) **Geochemistry of China's oilfield water discussed.** Jinlai, Z. 16 Jun 1980. Translated from Dizhi Pinglun; 25: No. 2, 64-69(Dec 1979). NTIS.

In China report: science and technology, No. 40.

A plan for classifying oilfield waters in China is presented. Current classification theories are discussed. The basic characteristics of oilfield waters in China are described. (DC)

33272 **Sulfur oxides control in catalytic cracking.** Blanton, W.A. Jr.; Jaffe, J. (to Chevron Research Co.). US Patent 4,166,787. 4 Sep 1979. Filed date 16 Dec 1977. 14p.

The amount of sulfur oxides in flue gas evolved in a catalyst regenerator in a catalytic cracking system is lowered by incorporating into the cracking catalyst, before using the catalyst in the cracking system, finely divided, high surface area alumina which has been calcined at 700 to 1600°F before incorporation into the catalyst. Sulfur oxides react with the calcined alumina in the regenerator to form a sulfur-containing solid. The sulfur-containing solid reacts with hydrocarbon to form fluid sulfur compounds in the FCC reactor, and the sulfur compounds exit the reactor mixed with the cracked hydrocarbons.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 33225, 33702, 33705

33273 **General order prescribing rules and regulations governing the conservation of oil and gas in Alabama and oil and gas laws of Alabama with Oil and Gas Board forms.** University, AL; State Oil and Gas Board of Alabama (1980). 141p.

The Alabama Legislature enacted the first oil and gas statute for the state in 1911. Since that time, the Alabama Legislature has periodically revised and amended the State's oil and gas laws. The current Alabama statutory law concerning oil and gas is set forth in this publication.

33274 (DOE/RA/33001—01(Vol.2)) **Refinery siting workbook: appendices C to O.** (Mittelhauser Corp., El Toro, CA (USA)). Jul 1980. Contract AC01-79RA33001. 642p. NTIS, PC A99/MF A01.

Applicable laws and permits available for the selection and building of petroleum refineries are enclosed. A glossary of pertinent terms is also included. References related to the National Environmental Policy Act, the Clean Air Act, the Federal Water Pollution Control Act, Resource Conservation and Recovery Act, Toxic Substance Control Act, and Wetlands and Coastal Zone are included. Permit information is also presented. (DC)

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 33275, 33276

PROPERTIES

REFER ALSO TO CITATION(S) 33844, 33845

33275 **Low pour point crude oil compositions.** Sweeney, W.M. (to Texaco Inc.). US Patent 4,178,951. 18 Dec 1979. Filed date 10 Oct 1978. 6p.

A crude oil composition having a low pour point is prepared by incorporating into a waxy crude oil an effective pour depressant amount of an oil-soluble polymer, such as vinyl acetate-ethylene-propylene or butylene terpolymer or a graft copolymer in which propylene or butylene is grafted onto an ethylene-vinyl acetate copolymer backbone or basic chain. The terpolymer may be added with mixing directly to the heated crude or in hydrocarbon solution such as a solution of the terpolymer in a middle distillate or kerosene. In another aspect, this invention relates to a process for the pipeline transportation of the crude oil compositions previously described.

33276 **Residual fuel compositions with low pour points.** Sweeney, W.M. (to Texaco Inc.). US Patent 4,178,950. 18 Dec 1979. Filed date 10 Oct 1978. 6p.

A low pour point residual fuel oil composition is prepared from a major amount of a high pour point, low sulfur, waxy, residual fuel and a minor amount of a low wax, low pour, residual fuel oil by adding thereto from 0.01 to 0.5% by weight of an oil soluble terpolymer such as vinyl acetate-ethylene-propylene or butylene or a graft copolymer in which propylene or butylene is grafted onto an ethylene-vinyl acetate copolymer backbone or basic chain, having preferably, a number average molecular weight of about 12,000 to about 60,000. In another aspect, this invention relates to a process for the pipeline transportation of the low pour residual fuel oil compositions previously described.

33277 **Low pour residual fuel compositions.** Sweeney, W.M. (to Texaco Inc.). US Patent 4,155,719. 22 May 1979. Filed date 23 Nov 1977. 6p.

Low pour fuel oil compositions are prepared by incorporating in a residual fuel a small amount of an oil-soluble terpolymer such as (1) a vinyl acetate-ethylene-methacrylic or acrylic acid ester terpolymer of (2) vinyl acetate-ethylene-oxyalkylated crylic acid terpolymer.

STORAGE

33278 (AD-A—076949) **Strategic petroleum reserve crude oil data search file documentation. Final report, June 1978-September 1979.** Eichelberger, J.R.; Stavinoha, L.L.; Giles, H.N. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Sep 1979. Contract DAAK70-78-C-0001. 31p. NTIS, PC A03/MF A01.

Crude oil analysis data for the years 1950-1977 were obtained on magnetic tape from the DOE Bartlesville Energy Technology Center and placed on the DOE Energy Information Administration's computer for use by the DOE Strategic Petroleum Reserve Office (SPRO). A data transformation program was written to convert the crude oil data to a new SPRO crude oil data file compatible with SPRO crude oil purchase specifications. This SPRO crude oil data file is searchable for the purposes of identifying and locating crude oils having properties within specified search limits.

NATURAL GAS

REFER ALSO TO CITATION(S) 33171

33279 **Proceedings of the fifty-ninth annual convention.** Tulsa, OK; Gas Processors Association (1980). 180p. (CONF-800394—).

From 59. annual convention of the Gas Processors Association; Houston, TX, USA (17 May 1980).

The 32 papers and 3 abstracts are grouped under the following headings: research reports, committee report (on synthetic fuels), general session, Western Hemisphere energy outlook, politics of energy in the 1980's, process technology, offshore gas operations, natural gas liquids demand, and gas treating technology. Separate abstracts were prepared for all the papers. (DLC)

RESERVES

REFER ALSO TO CITATION(S) 33286

33280 (LA—8368-MS) **Methane hydrate as an energy resource. A review with recommended future research.** Barraclough, B.L. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01.

A general review of current knowledge concerning the nature, evidence for natural occurrence, and resource potential of methane (natural gas) hydrate is presented. Soviet production technology is briefly surveyed, and an outline of research necessary for understanding, assessing, and exploiting this novel, unconventional energy resource is included.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 33496, 33497, 33498

33281 **Amine gas treating solution analysis: a tool in problem solving.** Pearce, R.L.; Grosso, S.; Cringle, D.C. (Dow Chemical USA, Freeport, TX). pp 150-162 of Proceedings of the fifty-ninth annual convention. Tulsa, OK; Gas Processors Association (1980).

From 59. annual convention of the Gas Processors Association; Houston, TX, USA (17 May 1980).

The analytical data gathered by the methods described can be used to interpret the operation of a gas scrubbing plant, improve its performance, and forestall difficulties. To illustrate this process, two case histories are presented and discussed. Many important properties can be determined at the plant site with quick, relatively simple analyses. In the event more detailed analyses are required, a sample must be sent to an appropriate laboratory. Care must be taken while collecting the sample to assure it is representative of the system, and in the handling and shipping of samples to the analytical laboratory. Optimization of plant operational parameters is possible with the judicious use of plant solution analyses. Certain analyses should be done routinely to assure that the plant is operating as desired and as predictive measures of a perhaps worsening condition before problems start.

33282 **High CO_2-high H_2S removal with SELEXOL solvent.** Sweny, J.W. (Allied Chemical Corp., Morristown, NJ). pp 163-166 of Proceedings of the fifty-ninth annual convention. Tulsa, OK; Gas Processors Association (1980).

From 59. annual convention of the Gas Processors Association; Houston, TX, USA (17 May 1980).

The SELEXOL Solvent Process has been established for bulk removal of acid gases and selective absorption of sulfur compounds. The acid gases include CO_2 and H_2S. This paper shows how the SELEXOL process can be used to meet any situation that arises in gas purification. 9 figures. (DLC)

33283 **Acid gas removal by versatile Shell processes.** Fisch, E.J. (Shell Oil Co., Houston, TX). pp 167-170 of Proceedings of the fifty-ninth annual convention. Tulsa, OK; Gas Processors Association (1980).

From 59. annual convention of the Gas Processors Association; Houston, TX, USA (17 May 1980).

Shell Oil Co.'s Sulfinol and ADIP processes have been in commercial use by the industry for over 15 years, and the combined worldwide installations using this technology number over 300 units. In recent years, changing economic and environmental forces have broadened the range of performance requirements for acid gas removal processes. As a consequence, the competitive positions of various treating processes have been affected, at least for certain situations. The versatility of Shell's processes in this milieu is demonstrated by the continuing increase in new applications and is the subject of this paper.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 33267, 33268

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 33269

33284 (FERC/EIS—0009) **Prudhoe Bay Project. Final Environmental Impact Statement: Docket No. CP78-123 et al.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation). Jul 1980. 433p. NTIS, PC A19/MF A01.

This FEIS evaluates the environmental impact of the gas conditioning and processing facilities to be constructed at Prudhoe Bay, Alaska, in association with the Alaska Natural Gas Transportation System (ANGTS), Docket No. CP78-123 et al. Using four processing trains, the sales gas conditioning facility (SGCF) would condition 2 billion cubic feet of gas per day with the SELEXOL process for the ANGTS to transport to the lower 48 states. The staff has also analyzed the environmental impact of an alternative site near the Yukon River and two alternative sites at Fairbanks, Alaska. The staff concludes that the proposed Prudhoe Bay site is environmentally acceptable. The staff finds the two alternative sites in the Fairbanks area to be acceptable as well. The alternative Yukon River site is less acceptable than either the proposed Prudhoe Bay site or the two alternative sites. In addition, the staff presents 11 recommendations for the ultimate developer of an SGCF at Prudhoe Bay.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

33285 (DOE/BC/10003—10) **Western Gas Sands Project. Status report, 1 May-31 May, 1980.** (CER Corp., Las Vegas, NV

(USA)). 1980. Contract AC08-79BC10003. 68p. NTIS, PC A04/MF A01.

This report summarizes the progress of the government-sponsored project directed towards increasing gas production from the low permeability gas sands of the western United States. The planning activities for the multi-well experiment continued in May. Bartlesville Energy Technology Center continued formation evaluation and reservoir simulation studies. Lawrence Livermore Laboratory continued calculations of fracturing near interfaces. Los Alamos Scientific Laboratory focused work on the permanent magnet system for NMR logging. Results of the 3-D Seismic Reflection Survey were presented by Sandia Laboratories. Production and injection experiments continued for the Colorado Interstate Gas Company Miller No. 1 and Sprague No. 1 wells. The DOE Well Test Facility was transported to Las Vegas for repairs and modifications. In situ testing continued at the Nevada Test Site for the Sandia Mineback program.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 33273, 33702, 33705

33286 (COO—4955-1) **Future role of geopressured resources in US energy policy: a scenario approach and analysis. Final report, July 1, 1978-March 31, 1979.** Brown, W.M. (Hudson Inst., Inc., Croton-on-Hudson, NY (USA)). 3 Apr 1979. Contract AC02-78ET28474. 66p. NTIS, PC A04/MF A01.

The potential contribution of future geopressured energy - especially methane - to the US and the world's needs is examined through several scenarios. Although such production may not become competitive, if it does the eventual producible reserves from the Gulf Coast region seem likely to fall between 100 and 10,000 quads. The world's potential from similar resources is not known but may well be 10 times as great. The contribution to the projected future demand for hydrocarbons is found to become substantial in most of the success scenarios. The potential impact on fuel imports and their future prices is discussed. Although technical uncertainties are far too great at present for accurate projections, this could change rapidly as field data becomes available from DOE's R and D program.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 33171

33287 **Synthetic fuels from oil shale: symposium papers.** Chicago, IL; Institute of Gas Technology (1980). 689p. (CONF-791209—). $60.00.

From Institute of Gas Technology symposium; Atlanta, GA, USA (3 Dec 1979).

The symposium included presentations on geology, mining, processing, refining, environmental aspects, and regulation of oil shales and shale oil. Separate abstracts are prepared for individual papers for inclusion in the Energy Data Base. (DC)

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

REFER ALSO TO CITATION(S) 33294

33288 (DOE/METC/10866—18) **Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee.** Roen, J.B.; Wallace, L.G.; Milici, R.C. (Geological Survey, Reston, VA (USA)). 1980. Contract AI21-79MC10866. 42p. NTIS, PC A03/MF A01.

The Tennessee Division of Geology under contract to the Morgantown Energy Technology Center of the US Department of Energy has drilled eight NX coreholes in eastern Tennessee. The coring program was designed to retrieve continuous cores for a detailed study of the character of the Chattanooga Shale. The geophysical wire-line logging of the NX drill holes was performed by the US Geological Survey. The lithologic and wire-line log data in conjunction with two seismic surveys will be used to evaluate the hydrocarbon potential of the Chattanooga Shale in northeastern Tennessee. The purpose of this report is to present a detailed lithologic description and gamma-ray log of the Tennessee Division of Geology and US Department of Energy cored drill holes no. 4 and 5 (TDG-DOE no. 4 and no. 5). In spite of the overlap, no distinct marker beds were found to facilitate a positive correlation between the two cores. Reconstruction of the total Chattanooga section was based on detailed field mapping of the uppermost dark-gray shale below the base of the Grainger Formation and the projection of the beds. The total thickness of the Chattanooga Shale at the coring locations is estimated to be 1650 to 1700 ft.

33289 (MLM-MU—80-68-0002) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1980.** Zielinski, R.E.; Moteff, J.D. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 291p. (MLM-EGSP-TPR-Q—014). NTIS, PC A13/MF A01.

The general location of wells and the corresponding well data used by the Mound Facility in its EGSP study of Devonian gas shales are presented. The data include: vitrinite, bitumen, and pyrolysis-GC analyses; biostratigraphy; depths; C1-C7 analysis; bulk density measurements; total organic carbon contents; lithology; kerogen analysis; permeability; dilatometry; and sorption studies. (DC)

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 33180, 33250

IN SITU METHODS, TRUE AND MODIFIED

33290 (DOE/LETC—1761-2/1) **Analysis of reverse combustion in tar sands: a one-dimensional model.** Amr, A. (Wyoming Univ., Laramie (USA)). Aug 1980. Contract AC03-78ET13101. 42p. NTIS, PC A03/MF A01.

This paper describes a one-dimensional numerical model which simulates oil recovery from tar sands by reverse combustion. The method of lines is used to solve the nonlinear differential equations describing the flow. The effects of volumetric air flux on the peak temperature, flame velocity, and oil recovery efficiency are reported. The results are compared to the results of relevant experimental studies.

33291 (FE—2346-74) **Energy from the in situ processing Antrim shale: process equipment used in the extraction trials.** Murdick, D.A. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Aug 1980. Contract AC01-76ET12153. 18p. (DOW/SR—74). NTIS, PC A02/MF A01.

As one phase of the 1976 contract between The Dow Chemical Company and the US Department of Energy investigating Antrim shale, three extraction trials were made at the shale research site at Peck, MI. This report is an overview of the process equipment used in those extraction trials. Equipment discussed in this report are: the air and nitrogen handling equipment, the methane fuel supply equipment, the field instrumentation, the flare, the well drying equipment, the control room and safety related equipment. After various problems related to each piece of equipment were solved, the equipment worked very well as a total unit. This functioning of the above ground equipment allowed the research group to focus most of its effort on the experimental problems encountered in the Antrim shale layer.

33292 (SAND—80-0777) **Effects of insulation for the steam string of the TS-1S experiment.** Wayland, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01.

The character of the steam quality at the production depth in the Laramie Energy Technology Center's Tar Sand steam injection field experiment is studied. A series of calculations were made using the BORE wellbore heat loss code. The results are given in graphical form along with simple functional fits for use in the field.

33293 (SAND—80-1873C) **Model capabilities for in-situ oil shale recovery.** Hommert, P.J.; Tyner, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 13p. (CONF-800804—25). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

The extensive oil shale reserves of the United States are now under development as an energy source. One of the approaches for extracting oil from shale is the so-called modified in-situ retort. The operation of such retorts for maximum yield requires an understanding of oil loss mechanisms so that operating strategies that minimize these losses can be developed. The present modeling capabilities for describing the behavior and yield from a modified in-situ retort are discussed. It is shown how the advances made in describing retort chemistry have greatly increased the predictive capabilities of these models. Two models that have been subject to comparison with laboratory retorts are described. The first is a one-dimensional model that treats the retort as a packed bed reactor, the second is a quasi-two-dimensional examination of block retorting. Both models are capable of predicting retorting rates, off gas composition and oil yield losses to coking and combustion. The block model, for example, describes conditions where local oil yield losses can be as high as

50%. Areas for further model improvement include additional work on describing retort chemistry, such as the steam/char and gas phase combustion reactions. The major need for modeling now is expansion to multi-dimensional simulation. This is necessary if a predictive capability is to be developed for field situations where sweep efficiency losses and gravitational effects become important.

33294 Dow true in situ process for recovery of energy from the Antrim shale. Lund, M.M.; Peil, C.A.; Pihlaja, R.K. (Dow Chemical Co., Midland, MI). Contract AC20-76LC10153. pp 417-438 of Synthetic fuels from oil shale: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Institute of Gas Technology symposium; Atlanta, GA, USA (3 Dec 1979).

The Dow Chemical Company, in cooperation with the US Department of Energy, is conducting a four-year, $14 million research program to test the feasibility of deep, in situ recovery of low-heat content gas from the Antrim shale of Michigan. This paper provides a progress report on several phases of that work. With the help of scientists and engineers at five Michigan universities as well as the Michigan Department of Natural Resources and the Environmental Research Institute of Michigan, a data base is being compiled which will allow assessment of the Antrim resource. Results of some of the geochemical, geophysical, lithological and mineralogical studies are presented and discussed. At Dow's field site, the three fracturing experiments have been completed. A brief review of these experiments along with an assessment of the results is given. A description of the analytical and data processing systems are included. Preliminary results of the true in situ retorting trial started in October 1979 are described.

REFINING

REFER ALSO TO CITATION(S) 33251, 33252, 33253, 33255, 33256, 33258, 33259, 33260, 33261, 33262, 33263

33295 Raw shale oil upgrading. Sullivan, R.F.; Stangeland, B.E.; Frumkin, H.A. (Chevron Research Co., Richmond, CA). Contract EF-76-C-01-2315. pp 629-653 of Synthetic fuels from oil shale: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Institute of Gas Technology symposium; Atlanta, GA, USA (3 Dec 1979).

Shale oil presents unusual refining problems. It is notable for high nitrogen content which can lead to poor product quality. It also contains large amounts of unsaturated hydrocarbons and metallic contaminants. Its unusual properties prevent its being mixed with crude oils for processing in most existing refineries. However, advanced commercial state-of-the art refining technology is capable of refining shale oil, either alone or mixed with crude. The key to successful shale oil refining is an effective initial hydrotreating step. This removes the contaminants and permits the use of conventional hydrocracking or fluid catalytic cracking (FCC). Distillates from coking of raw shale oil also require subsequent hydrotreating to remove residual impurities and meet final product specifications. A pilot plant refining study on surface retorted Paraho shale oil was recently completed by Chevron Research Company under a US Department of Energy (DOE) contract. Three basic shale oil processing routes for the production of transprotation fuels were studied: hydrotreating followed by hydrocracking, hydrotreating followed by FCC, and severe coking followed by hydrotreating. Also, a fourth alternate was evaluated in which raw shale oil was hydrotreated to produce a synthetic crude suitable for processing in an existing refinery. In this paper, product yields, product properties, and estimated process costs derived from these studies are presented. It is concluded that shale oil can be refined to high quality transportation fuels via modern state-of-the art refining technology and that it can serve as a substitute for crude oil in a refinery equipped with modern hydrotreating facilities.

PURIFICATION

REFER ALSO TO CITATION(S) 33253, 33254, 33257

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 33277, 33289

33296 (LBL—9062) **Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting.** Fox, J.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 454p. NTIS, PC A20/MF A01.

Thesis.

The fate of inorganic constituents in Green River, Antrim, and Moroccan oil shales during in-situ retorting has been investigated. The partitioning or distribution of 50 elements to the spent shale, shale oil, retort water, and gases was studied by completing mass balances for several runs of three simulated in-situ retorts. Byproducts and products from 24 simulated in-situ retort runs were analyzed. The effect of shale origin and retort operating conditions, including temperature, particle size, atmosphere, and gas flow rate, on partitioning patterns was investigated, and the resulting data were used to develop a conceptual model of elemental partitioning during simulated in-situ retorting. Most of the 50 elements studied are not significantly mobilized during in-situ retorting. The only elements that are distributed in large quantities to the by-products are C, H, N, S, Cd, and Hg. Lesser but environmentally significant quatities of Se, As, Ni, and Co are distributed to the oils and waters, and at retorting temperatures in excess of about 900°C, Se is mobilized to the gas phase. Mercury and Cd were the most mobile trace metals studied. About 70% of the Hg and 30% of the Cd were distributed to the gas phase. Mercury was released as a series of pulses in the last third of a retort run. Thermodynamic calculations indicated that elemental Hg is the major stable gas-phase species in all zones of an in-situ retort. The work demonstrated that elemental partitioning is controlled by the mineral residence of an element and the retort operating conditions employed. Significant differences were observed in the mobility and partitioning patterns of Green River, Antrim, and Moroccan oil shales. The only retorting conditions that had a statistically significant effect on partitioning patterns were temperature, input gas, particularly steam, and retort design and operation.

33297 Current methods of oil shale analysis and new developments (NMR). Miknis, F.P. (Laramie Energy Technology Center, Laramie, WY). pp 245-269 of Synthetic fuels from oil shale: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Institute of Gas Technology symposium; Atlanta, GA, USA (3 Dec 1979).

This paper reviews some methods of analysis of oil shales that are currently used by the Laramie Energy Technology Center, and describes new developments in magnetic resonance for the analysis of oil shales. Analytical methods that are discussed include the determination of the elemental composition of oil shales, and assay methods to determine potential oil yields. Cross polarization, magic angle spinning carbon-13 nuclear magnetic resonance spectra and results are presented to illustrate the type of information that is obtainable for oil shales with the new magnetic resonance techniques.

33298 High resolution NMR spectroscopy: its application to shale oil component/type analysis. Netzel, D.A. (Laramie Energy Technology Center, Laramie, WY). pp 271-304 of Synthetic fuels from oil shale: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Institute of Gas Technology symposium; Atlanta, GA, USA (3 Dec 1979).

A brief review is given of the state-of-the-art in shale oil analysis by instrumental methods with emphasis on high resolution nuclear magnetic resonance (NMR) spectroscopy. The technique was applied to the analysis of saturate, olefin and aromatic cuts from the naphtha and light distillate fractions obtained from shale oil. The types of alkanes present in the saturate cut, as well as their percent branching and average carbon number were determined. Also described is the use of carbon-13 NMR to determine the location of the double bonds in the olefin cuts, and to determine certain average molecular properties for the aromatic cuts.

WASTE RESEARCH AND MANAGEMENT

33299 (LBL—11072) **Potential uses of spent shale in the treatment of oil shale retort waters.** Fox, J.P.; Jackson, D.E.; Sakaji, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 12p. (CONF-800425—6). NTIS, PC A02/MF A01.

From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

This paper evaluates two potential uses of spent shale for the treatment of in-situ oil shale process waters - in-situ treatment in an abandoned retort and surface treatment by columns of spent shale. Batch and column studies were conducted using four in-situ retort waters, one gas condensate, and six spent shales. The effect of spent shale contact on the organic and inorganic carbon, conductivity, and pH of the waters was determined and related to specific surface area of the shale and retort operating conditions. These studies indicate that spent shale may be used to reduce the organic and inorganic carbon, conductivity, color, and odor and to elevate the pH of retort waters and gas condensate. Spent shale reduces the inorganic carbon by 47 to 98%, the organic carbon by 7 to 66%, and elevates the pH from initial levels of 8 to 9 up to 10 to 11. TOSCO II spent shale was the best adsorbent for organic carbon, while Lurgi and simulated in-situ spent shales achieved the highest inorganic carbon reduction. These results suggest that a packed bed of spent shale could be placed ahead of an ammonia removal step in a retort water treatment

system. The increase in pH achieved by the spent shale column would convert ammonium to ammonia which could be readily stripped. The simultaneous reduction in electrical conductivity and dissolved organic and inorganic carbon by the spent shale column would decrease the load of these constituents on subsequent treatment steps.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33272, 34127, 34147, 34202

NUCLEAR FUELS

NUCLEAR FUELS

RESERVES

33300 (LA—8440-MS) **Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada.** Curtis, D.B.; Gancarz, A.J. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01.

The redistribution of uranium, thorium, and lead is being examined in samples representing several million cubic meters of sandstone and metamorphased sediments in the Athabasca Basin which is located in the northwest corner of the Canadian province of Saskatchewan. The region of study includes zones of uranium mineralization at Key Lake. Mineralization occurs at the unconformity between the Athabasca sandstone and the underlying metasediments and in fault zones within the metasediments. Lead isotopes record a radiometric age of 1300 +- 150 m.y. in samples from above and below the unconformity. This age probably reflects the time of deposition of the sandstones and an associated redistribution of uranium and/or lead in the underlying rocks. Many of the samples have been fractionated with respect to radiogenic lead and the actinide parent elements since that time. Sandstones and altered rocks from the region above the unconformity have been a transport path and are a repository for lead. In contrast, mineralized rocks are deficient in radiogenic lead and must be an important source of lead in the local geologic environment. However, the isotopic composition of lead missing from the ores is different from that found in the overlying sandstones. The two types of rocks do not appear to represent complements with respect to a source and a repository for lead.

EXPLORATION

REFER ALSO TO CITATION(S) 34165

33301 (GJBX—124(80)) **Engineering report on the Great Divide Basin drilling project Sweetwater County, Wyoming, May 1980.** Jones, L.I. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jul 1980. Contract AC13-76GJ01664. 20p. NTIS, PC E01/MF $3.50.

This drilling project was conducted by Bendix Field Engineering Corporation (BFEC) in support of the US Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program to provide additional information for a study already in progress. During the fall of 1979, six holes were drilled in the same area at depths of less than 1000 feet (304.80 m). The results of the 1979 drilling are available as GJBX-50(80) and GJBX-51(80) through the BFEC technical library. The four holes reported in this study ranged in depth from 2335 to 2500 feet (711.71-762.0 m); a total of 9771 feet (2978.20 m), of which 7 feet (2.13 m) were cored. A total of 100 feet (30.48 m) of sidewall samples was taken from three holes. Geophysical logging was supplied by BFEC. The objective of this project was to test the uranium potential of the Battle Spring Formation (Eocene). Drilling began May 3 and was finished on May 22, 1980.

33302 (GJBX—160(80)) **Aerial radiometric and magnetic survey: San Antonio National Topographic Map, Texas. Final report.** (Geodata International, Inc., Dallas, TX (USA)). May 1980. Contract AC13-76GJ01664. 296p. NTIS, PC E11/MF $12.20.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the San Antonio National Topographic Map NH14-8 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

33303 (GJBX—163(80)) **Elko 1^0 x 2^0 NTMS area: Nevada and Utah. Data report.** Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13—76GJ01664. 57p. (DPST—80-146-4). NTIS, PC E03/MF $3.50.

Results of ground water and surface sediment reconnaissance in the National Topographic Map Series (NTMS) Elko 1^0 x 2^0 quadrangle are presented. The target sampling density was one site per 12 square kilometers. This resulted in 1713 sediment samples being collected; however, dry conditions and sparce population contributed to the relatively small number of ground water (154) samples collected. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements (where available) for pH, conductivity, and alkalinity, and (2) elemental analyses (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (coordinates, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements, U/Th and U/Hf ratios, and scintillometer readings for sediment samples are included.

33304 (GJBX—164(80)) **Stream sediment detailed geochemical survey for Date Creek Basin, Arizona.** Butz, T.R.; Tieman, D.J.; Grimes, J.G.; Bard, C.S.; Helgerson, R.N.; Pritz, P.M. (Oak Ridge National Lab., TN (USA)). 30 Jun 1980. Contract AC13-76GJ01664. 236p. (K/UR—34). NTIS, PC E06/MF $3.50.

Results of the Date Creek Basin detailed geochemical survey are reported. Field and laboratory data are reported for 239 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Based on stream sediment geochemical data, significant concentrations of uranium are restricted to the Anderson Mine area. The 84th percentile concentrations of U-FL, U-NT, and U-FL/U-NT combined with low thorium/U-NT values reflect increased mobility and enrichment of uranium in the carbonate host rocks of that area. Elements characteristically associated with the uranium mineralization include lithium and arsenic. No well defined diffusion halos suggesting outliers of similar uranium mineralization were observed from the stream sediment data in other areas of the Date Creek Basin. Significant concentrations of U-FL or U-NT found outside the mine area are generally coincident with low U-FL/U-NT values and high concentrations of zirconium, titanium, and phosphorus. This suggests that the uranium is related to a resistate mineral assemblage derived from surrounding crystalline igneous and metamorphic rocks.

FEED PROCESSING

REFER ALSO TO CITATION(S) 33494, 33495

ENRICHMENT

33305 (AD-A—076907) **The jet membrane process for uranium separation and enrichment. Final report on phase 2.** Brook, J.W.; Calia, V. (Grumman Aerospace Corp., Bethpage, NY (USA). Research Dept.). Sep 1979. 147p. NTIS, PC A07/MF A01.

The jet membrane is a new aerodynamic separation concept for enriching uranium. The project described in this report had two objectives: 1) to demonstrate experimentally that uranium isotopes can be separated using the jet membrane concept, and 2) to make an assessment of the economic viability of the jet membrane in relation

to competing processes. To address the first objective a laboratory suitable for handling UF6 was outfitted, a jet membrane apparatus compatible with UF6 was constructed, and a mass spectrometer capable of providing the necessary precision for UF6 isotope measurements was purchased. Isotopic enrichment of both SF6 and UF6 was successfully demonstrated in our laboratory using the jet membrane apparatus. To aid in addressing the second objective two separate laboratory facilities were constructed. Program supporting experiments were conducted in these laboratories, using a variety of gas combinations, to investigate those system parameters that were identified in our economics analysis as major capital and energy cost drivers. In addition, a theoretical study was conducted to aid in analyzing data and to provide scaling laws. Our cost analysis, based upon the measured UF6 results and the supporting experiments, indicates that the jet membrane is a viable concept for enriching uranium industrially.

CENTRIFUGATION

REFER ALSO TO CITATION(S) 33347

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 33619

33306 (AGNS—35900-CONF-71) **Mixed oxide conversion facility alternative conceptual designs.** Thomas, L.L. (Allied-General Nuclear Services, Barnwell, SC (USA)). Mar 1980. Contract AC09-78ET35900. 20p. (CONF-800943—5). NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Allied-General Nuclear Services recently performed studies to evaluate alternative proliferation-resistant flowsheets of the uranium-based LWR fuel cycle. The alternatives evaluated consist of coprocessing schemes with either a gamma or a heat spike added. A literature search and evaluation were performed to select a process technology for mixed oxide coconversion. The COPRECAL process was chosen as the most suitable conversion process technology. Three alternative mixed oxide conversion facility design concepts were prepared based on the COPRECAL technology. These alternative concepts are compared to a pure plutonium conversion facility. Facility designs, relative proliferation resistance, and cost estimates are discussed.

33307 (CONF-800802—12) **Preparation of thorium-uranium gel spheres.** Spence, R.D.; Haas, P.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Ceramic oxide spheres with diameters of 15 to 1500 μm are being evaluated for fabrication of power reactor fuel rods. $(Th,U)O_2$ spheres can be prepared by internal or external chemical gelation of nitrate solutions or oxide sols. Two established external gelation techniques were tested but proved to be unsatisfactory for the intended application. Established internal gelation techniques for UO_2 spheres were applied with minor modifications to make 75% ThO_2-25% UO_2 spheres that sinter to diameters of 200 to 1400 μm (99% T.D.).

33308 (NBL—296) **Dissolution of HTGR TRISO beads by the alkali fluoride fusion method.** Byster, S.E. (Department of Energy, Argonne, IL (USA). New Brunswick Lab.). Jul 1980. 9p. NTIS, PC A02/MF A01.

The alkali fluoride fusion method for the dissolution of HTGR TRISO fuel beads offers significant time advantage over other commonly used fusion procedures when applied to samples weighing less than three grams. The method is straightforward, utilizes standard analytical laboratory equipment, and yields solutions which may be utilized by customary procedures.

TRANSPORT AND STORAGE

33309 (DOE/NV/10061—3) **Spent fuel handling and packaging program. Quarterly report, April-June 1980.** Durrill, D.C. (Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.). Jul 1980. Contract AC08-80NV10061. 19p. NTIS, PC A02/MF A01.

This document is a report of activities performed by Westinghouse Advanced Energy Systems Division-Nevada Operations at the E-MAD Facility, Area 25, Nevada Test Site, in meeting subtask objectives during the third quarter of FY 1980. Activities during this period included completion of encapsulation and preparation for shipment of 11 spent fuel assemblies to be tested at the Climax test site by Lawrence Livermore Laboratories; calorimetry of two fuel assemblies; repeat of three 1 kW Fuel Temperature Test runs; acquisition of gas samples from fueled canisters; removal of ten R-MAD shielding windows; and assembly and checkout of the canister cutter, which was received from AESD-Large.

33310 (HEDL-SA—2138) **Spent fuel resistance to internally produced cladding degradation.** Einziger, R.E.; Cantley, D.A.; Krogness, J.C.; Stellrecht, D.E.; Pasupathi, V. (Westinghouse Hanford Co., Richland, WA (USA); Battelle Columbus Labs., OH (USA)). May 1980. Contract AC14-76FF02170. 15p. (CONF-8005107—1). NTIS, PC A02/MF A01.

From Alternate waste form information workshop; Gatlinburg, TN, USA (13 May 1980).

These tests were conducted over a narrow temperature range considerably above anticipated disposal conditions and utilized only one set of rods from a single reactor. The following conclusions are made: The measured cladding strain was sufficiently large so that failure mechanism verification by inducing breaches in unmodified rods heated to elevated temperatures for short periods of time does not appear to be practical based on a stress rupture mechanism. At the elevated test temperatures, though, Blackburn's formulization based on stress rupture gives very conservative estimates of breach times. In addition to the high cladding strain, the fuel exhibited no additional gas release or axial fission product migration at 482°C. The nondestructive examination gave no additional indication of internal deterioration of the fuel rod.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 33318

33311 (DOE/RA—0053) **Survey of United States uranium marketing activity.** Combs, G.F. Jr.; Krusiewski, S.V. (Department of Energy, Washington, DC (USA). Office of Uranium Resources and Enrichment). Jul 1980. 21p. NTIS, PC A02/MF A01.

In 1979 US buyers contracted for a net increase of 15,400 tons U_3O_8 in new procurement after deducting for changes to January 1, 1979, commitments. Export commitments made in 1979 totalled 2800 tons, while import commitments amounted to 1000 tons U_3O_8. Buyers' inventories of domestic- and foreign-origin normal and enriched uranium increased to 52,300 tons U_3O_8 during 1979, with the larger part of the increase being in enriched uranium. The average price reported for 1979 deliveries was $23.85 per pound of U_3O_8. Settlements of market price contracts average $42.55 for 1979 delivery and $45.80 for 1980 delivery. Producers expect to be able to offer 33,700 tons U_3O_8 for sale in the 1980-1985 period, about 20% less than was estimated in the 1979 survey. Utilities made sales of 500 tons U_3O_8 for 1979-1980 delivery as well as loans of 1600 tons U_3O_8 that are to be repaid by 1984; more than half of these sales or loans were made to uranium producers. Reactor manufacturers have sold about 1100 tons U_3O_8 since January 1, 1979, and loaned 120 tons. Unfilled requirements have decreased more than 100,000 tons U_3O_8 since January 1, 1978, and currently total 75,700 tons U_3O_8. Responses to the 1980 survey suggest that there seems to be an adequate supply of uranium to meet US demand at least through 1985.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 34108

33312 (DP—79-125-3) **Waste management program technical progress report, July-September 1979.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC09-76SR00001. 50p. NTIS, PC A03/MF A01.

This quarterly report provides current information on operations and development programs for the management of radioactive wastes generated at the Savannah River Plant. The operational status and research progress are reported for the surveillance and maintenance and waste tank evaluation portions of the SR Interim Waste Program, for the process and equipment development studies of the Long-Term HLW Management R and D Program, and for the Office of Nuclear Waste Isolation studies of Other Waste Programs.

33313 (DP-MS—80-73) **National perspective on waste management.** Crandall, J.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001 47p. (CONF-800655—30). NTIS, PC A03/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

Sources of nuclear wastes are listed and the quantities of these wastes per year are given. Methods of processing and disposing of mining and milling wastes, low-level wastes, decommissioning wastes, high-level wastes, reprocessing wastes, spent fuels, and transuranic wastes are discussed. The costs and safeguards involved in the management of this radioactive wastes are briefly covered in this presentation. (DC)

33314 (ORO—778) **Spent fuel and waste inventories and projections.** Carter, W.L.; Finney, B.C.; Alexander, C.W.; Blomeke, J.O.; McNair, J.M. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 88p. NTIS, PC A05/MF A01.

Current inventories of commercial spent fuels and both commercial and US Department of Energy radioactive wastes were compiled, based on judgments of the most reliable information available from Government sources and the open literature. Future waste generation rates and quantities to be accumulated over the remainder of this century are also presented, based on a present projection of US commercial nuclear power growth and expected defense-related activities. Spent fuel projections are based on the current DOE/EIA estimate of nuclear growth, which projects 180 GW(e) in the year 2000. It is recognized that the calculated spent fuel discharges are probably high in view of recent reactor cancellations; hence adjustments will be made in future updates of this report. Wastes considered, on a chapter-by-chapter basis, are: spent fuel, high-level wastes, transuranic wastes, low-level wastes, mill tailings (active sites), and remedial action wastes. The latter category includes mill tailings (inactive sites), surplus facilities, formerly utilized sites, and the Grand Junction Project. For each category, waste volume inventories and projections are given through the year 2000. The land usage requirements are given for storage/disposal of low-level and transuranic wastes, and for present inventories of mill tailings.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 33925, 33933

33315 (CONF-800814—12) **Microbial uptake of uranium, cesium, and radium.** Strandberg, G.W.; Shumate, S.E. II; Parrott, J.R. Jr.; McWhirter, D.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 35p. NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

The ability of diverse microbial species to concentrate uranium, cesium, and radium was examined. Saccharomyces cerevisiae, Pseudomonas aeruginosa, and a mixed culture of denitrifying bacteria accumulated uranium to 10 to 15% of the dry cell weight. Only a fraction of the cells in a given population had visible uranium deposits in electron micrographs. While metabolism was not required for uranium uptake, mechanistic differences in the metal uptake process were indicated. Uranium accumulated slowly (hours) on the surface of S. cerevisiae and was subject to environmental factors (i.e., temperature, pH, interfering cations and anions). In contrast, P. aeruginosa and the mixed culture of denitrifying bacteria accumulated uranium rapidly (minutes) as dense, apparently random, intracellular deposits. This very rapid accumulation has prevented us from determining whether the uptake rate during the transient between the initial and equilibrium distribution of uranium is affected by environmental conditions. However, the final equilibrium distributions are not affected by those conditions which affect uptake by S. cerevisiae. Cesium and radium were concentrated to a considerably lesser extent than uranium by the several microbial species tested. The potential utility of microorganisms for the removal and concentration of these metals from nuclear processing wastes and several bioreactor designs for contacting microorganisms with contaminated waste streams will be discussed.

33316 (DOE/TIC—11219) **Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1 Jun 1980. Contract AC09-76SR00001. 34p. NTIS, PC A03/MF A01.

The objective of this study was to review the relative merits and potential of 15 (fifteen) alternative waste forms being considered for the solidification and disposal of radioactive wastes. The relative merits of 4 (four) alternative pre-solidification processing approaches were also assessed in this study. A Peer Review Panel composed of 8 (eight) scientists and engineers representing independent, non-DOE laboratories from industry, government, and universities and the disciplines of materials science, ceramics, glass, metallurgy, and geology conducted the review. A numerical rating of alternative waste forms was arrived at individually by the panel members taking into consideration 9 (nine) scientific and 9 (nine) engineering parameters affecting the long term performance and production of waste forms. At a meeting on May 9, 1980, a group ranking for the alternative forms was achieved by averaging the individual scores and discussing the available data base. Three final ranking lists comparing: (A) Present Scientific Merits or Least Risk for Use Today; and (B) Research Priority; and (C) Present and Potential Engineering Practicality were prepared by the Panel. Each waste form in the lists is assigned a value of either (1) Top Rank, (2) Intermediate Rank, or (3) Bottom Rank. A discussion of the relative strengths and weaknesses of the alternative waste forms and recommendations for future program directions is presented in the body of the accompanying Peer Review Panel report.

33317 (PNL—3290) **Asphalt emulsion sealing of uranium mill tailings. 1979 annual report.** Hartley, J.N.; Koehmstedt, P.L.; Esterl, D.J.; Freeman, H.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 86p. NTIS, PC A05/MF A01.

Uranium mill tailings are a source of low-level radiation and radioactive materials that may be released into the environment. Stabilization or disposal of these tailings in a safe and environmentally sound way is necessary to minimize radon exhalation and other radioactive releases. One of the most promising concepts for stabilizing uranium tailings is being investigated at the Pacific Northwest Laboratory: the use of asphalt emulsion to contain radon and other potentially hazardous materials in uranium tailings. Results of these studies indicate that radon flux from uranium tailings can be reduced by greater than 99% by covering the tailings with an asphalt emulsion that is poured on or sprayed on (3.0 to 7.0 mm thick), or mixed with some of the tailings and compacted to form an admixture seal (2.5 to 15.2 cm) containing 18 wt % residual asphalt.

33318 (PNL-SA—8014) **Decommissioning of commercial shallow-land burial sites.** Murphy, E.S.; Holter, G.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 15p. (CONF-790923—13). NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

Estimated costs and safety considerations for decommissioning LLW burial grounds have been evaluated. Calculations are based on a generic burial ground assumed to be located at a western and an eastern site. Decommissioning modes include: (1) site stabilization followed by long-term care of the site; and (2) waste relocation. Site stabilization is estimated to cost from $0.4 million to $7.5 million, depending on the site and the stabilization option chosen. Long-term care is estimated to cost about $100,000 annually, with somewhat higher costs during early years because of increased site maintenance and environmental monitoring requirements. Long-term care is required until the site is released for unrestricted public use. Occupational and public safety impacts of site stabilization and long-term care are estimated to be small. Relocation of all the waste from a reference burial ground is estimated to cost more than $1.4 billion and to require more than 20 years for completion. Over 90% of the cost is associated with packaging, transportation, and offsite disposal of the exhumed waste. Waste relocation results in significant radiation exposure to decommissioning workers.

33319 (PNL-SA—8414) **Uranium mill tailings stabilization.** Hartley, J.N.; Koehmstedt, P.L.; Esterl, D.J.; Freeman, H.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract AC06-76RL01830. 16p. (CONF-800313—9). NTIS, PC A02/MF A01.

From Waste management conference; Tucson, AZ, USA (10 Mar 1980).

Uranium mill tailings pose a potential radiation health hazard to the public. Therefore, stabilization or disposal of these tailings in a safe and environmentally sound way is needed to minimize radon exhalation and other environmental hazards. One of the most promising concepts for stabilizing U tailings is the use of asphalt emulsion to contain radon and other hazardous materials within uranium tailings. This approach is being investigated at the Pacific Northwest Laboratory. Results of these studies indicate that a radon flux reduction of greater than 99% can be obtained using either a poured-on/sprayed-on seal (3.0 to 7.0 mm thick) or an admixture seal (2.5 to 12.7 cm thick) containing about 18 wt % residual asphalt. A field test was carried out in June 1979 at the Grand Junction tailings pile in order to demonstrate the sealing process. A reduction in radon flux ranging from 4.5 to greater than 99% (76% average) was achieved using a 15.2-cm (6-in.) admix seal with a sprayed-on top coat. A hydrostatic stabilizer was used to apply the admix. Following compaction, a spray coat seal was applied over the admix as the final step in construction of a radon seal. Overburden was applied to provide a protective soil layer over the seal. Included in part of the overburden was a herbicide to prevent root penetration.

33320 (RFP--2945) **Fluidized bed incineration process design for transuranic waste.** Johnson, A.J.; Meyer, F.G.; Anderson, D.L.; Bell, B.A.; Feng, P.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 19 Jul 1980. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01.

A fluidized bed incineration facility has been installed at the Rocky Flats Plant to develop and demonstrate a process for the

combustion of transuranic waste. The unit's capacity is about 82 kg/hr of combustible solid waste, which is nine times higher than the rate for the operating pilot-scale unit. The facility utilizes nonaqueous, in situ neutralization of acid gases. These gases are generated during the combustion of halogen-containing materials. The low-temperature (550 °C) operation eliminates refractory-lined equipment.

33321 (RHO-SA—174) **Transmutation of radwaste using accelerators.** Bruns, L.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1980. Contract AC06-77RL01030. 18p. (CONF-800743—9). NTIS, PC A02/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

A concept was proposed by Rockwell Hanford Operations, a prime contractor for the Department of Energy (DOE), to deactivate specified nuclear wastes. Work to date was first reviewed which included literature and meetings. Criteria for feasibility were established. Accelerator concepts to meet the criteria centered on the spallation accelerator with added moderation and boost mode. Optimum target was envisioned to be a combination actinide blanket with center fission product core. A figure plotting fraction transmuted vs. time in days showed what fluxes and cross-sections were necessary to achieve practicality. Problems that need to be faced were discussed. The Rockwell proposal was reviewed followed by conclusions and future work proposed.

33322 **Recovering actinide values.** Horwitz, E.P.; Mason, G.W. (to Department of Energy, Washington, DC (USA)). British Patent 2,027,257/A/. 13 Feb 1980. 5p.

Actinide values are recovered from sodium carbonate scrub waste solutions containing these and other values along with organic compounds resulting from the radiolytic and hydrolytic degradation of neutral organophosphorus extractants such as tri-n butyl phosphate (TBP) and dihexyl-N, N-diethyl carbamylmethylene phosphonate (DHDECMP) which have been used in the reprocessing of irradiated nuclear reactor fuels. The scrub waste solution is made acidic with mineral acid, to form a feed solution which is then contacted with a water-immiscible, highly polar organic extractant which selectively extracts the degradation products from the feed solution. The feed solution can then be processed to recover the actinides for storage or recycled back into the high-level waste process stream. The extractant can be recycled after stripping the degradation products with a neutral sodium carbonate solution.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 34223, 34226

33323 (DP-MS—80-47) **Prediction of the lifetime of canisters for solidified radioactive wastes.** Rankin, W.N. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 12p. (CONF-801043—1). NTIS, PC A02/MF A01.

From NACE meeting; El Paso, TX, USA (28 Oct 1980).

The lifetime of canisters for solidified high-level radioactive waste was predicted by extrapolating the thickness of reaction zones on both the inside and outside of candidate canister alloys when these alloys were in contact with typical waste and repository materials. Candidate canister alloys in close contact with both glass and concrete waste forms and with salt from a potential repository site were heated for 20,000 hours at temperatures expected during geologic storage of the waste forms. Results showed that 3/8-in.-thick Type 304L stainless steel canisters of waste glass or waste concrete stored in air or in dry salt would not be penetrated by reaction with the contents of the canister and oxidation of the outside of the canister for more than 8000 years. Oxidation would penetrate a similar low-carbon steel canister stored in air in about 200 years.

33324 (LA—8297-PR) **Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979.** Barnhart, B.J.; Campbell, E.W.; Martinez, E.; Caldwell, D.E.; Hallett, R. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01.

Previous results were confirmed showing elevated frequencies of radiation-resistant bacteria in microorganisms isolated from shallow transuranic (TRU) burial soil that exhibits nanocurie levels of beta and gamma radioactivity. Research to determine whether plutonium could be methylated by the microbially produced methyl donor, methylcobalamine, was terminated when literature and consulting radiochemists confirmed that other alkylated transuranic elements are extremely short-lived in the presence of oxygen. Emphasis was placed on investigation of the dissolution of plutonium dioxide by complex formation between plutonium and a polyhydroxamate chelate similar to that produced by microorganisms. New chromatographic and spectrophotometric evidence supports previous results showing enhanced dissolution of alpha radioactivity when ^{239}Pu dioxide was mixed with the chelate Desferol. Microbial degradation studies of citrate, ethylenediamine tetraacetate (EDTA), and nitrilo triacetate (NTA) chelates of europium are in progress. Current results are summarized. All of the chelates were found to degrade. The average half-life for citrate, NTA, and EDTA was 3.2, 8.0, and 28 years, respectively. Microbial CO_2 generation is also in progress in 72 tests on several waste matrices under potential WIPP isolation conditions. The mean rate of gas generation was 5.97 μg CO_2/g waste/day. Increasing temperature increased rates of microbial gas generation across treatments of brine, varying water content, nutrient additions, and anaerobic conditions. No microbial growth was detected in experiments to enumerate and identify the microorganisms in rocksalt cores from the proposed WIPP site. This report contains the year's research results and recommendations derived for the design of safe storage of TRU wastes under geologic repository conditions.

33325 (LBL—10541) **Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt.** Benson, L.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01.

An extensive search of the literature has been made for ion exchange data on smectites, certain zeolites and basalt. The data are in the form of thermodynamic equilibrium constants, corrected selectivity coefficients, and distribution coefficients. Room temperature alkali and alkaline earth metal cation ion exchange data for smectites are extensive. Correlation between the exchange free energies of alkali metal cations on Camp Berteau montmorillonite values with their Debeye-Hueckel parameter was found. Significant differences in values of exchange constants for the same reaction on different smectites were noted. While this in part may be attributable to differences in experimental procedures, much of the variance is probably due to differences in charge densities and the effective field strengths of the smectites. Differences in field strength are related to the type and amount of substitution on intercrystalline octahedral and tetrahedral sites. Data on smectites suggest that cation exchange selectivities are very strong functions of temperature. Experiments on the exchange properties of clinoptilolite and mordenite have been generally confined to alkali and alkaline earth cations although data for certain transition metal ions are also available for synthetic mordenite. The temperature dependences of zeolite exchange selectivities remain largely unknown. Distribution coefficients for groundwater-basalt systems have been measured for a variety of elements at temperatures up to 150°C. Steady state concentrations are often never achieved either from the sorption or the desorption side. Classical models of ion exchange have been applied successfully to zeolite and smectite exchange reactions. The sorption behavior of a basalt is better treated with models of the interface which take surface ionization and complexation into account.

33326 (ORNL/Sub—79/13617/2) **Low level waste management: a compilation of models and monitoring techniques. Volume 1.** Mosier, J.E.; Fowler, J.R.; Barton, C.J. (comps.). (Science Applications, Inc., Oak Ridge, TN (USA)). Apr 1980. Contract W-7405-ENG-26. 633p. (SAI/OR—565-2). NTIS, PC A99/MF A01.

In support of the National Low-Level Waste (LLW) Management Research and Development Program being carried out at Oak Ridge National Laboratory, Science Applications, Inc., conducted a survey of models and monitoring techniques associated with the transport of radionuclides and other chemical species from LLW burial sites. As a result of this survey, approximately 350 models were identified. For each model the purpose and a brief description are presented. To the extent possible, a point of contact and reference material are identified. The models are organized into six technical categories: atmospheric transport, dosimetry, food chain, groundwater transport, soil transport, and surface water transport. About 4% of the models identified covered other aspects of LLW management and are placed in a miscellaneous category. A preliminary assessment of all these models was performed to determine their ability to analyze the transport of other chemical species. The models that appeared to be applicable are identified. A brief survey of the state-of-the-art techniques employed to monitor LLW burial sites is also presented, along with a very brief discussion of up-to-date burial techniques.

33327 (ORNL/TM—7201) **Expected environments in high-level nuclear waste and spent fuel repositories in salt.** Claiborne, H.C.; Rickertsen, L.D., Graham, R.F. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 206p. NTIS, PC A10/MF A01.

The purpose of this report is to describe the expected environments associated with high-level waste (HLW) and spent fuel (SF) repositories in salt formations. These environments include the thermal, fluid, pressure, brine chemistry, and radiation fields predicted for the repository conceptual designs. In this study, it is assumed that the repository will be a room and pillar mine in a rock-salt formation, with the disposal horizon located ~ 2000 ft (610 m) below the surface of the earth. Canistered waste packages containing

HLW in a solid matrix or SF elements are emplaced in vertical holes in the floor of the rooms. The emplacement holes are backfilled with crushed salt or other material and sealed at some later time. Sensitivity studies are presented to show the effect of changing the areal heat load, the canister heat load, the barrier material and thickness, ventilation of the storage room, and adding a second row to the emplacement configuration. The calculated thermal environment is used as input for brine migration calculations. The vapor and gas pressure will gradually attain the lithostatic pressure in a sealed repository. In the unlikely event that an emplacement hole will become sealed in relatively early years, the vapor space pressure was calculated for three scenarios (i.e., no hole closure - no backfill, no hole closure - backfill, and hole closure - no backfill). It was assumed that the gas in the system consisted of air and water vapor in equilibrium with brine. A computer code (REPRESS) was developed assuming that these changes occur slowly (equilibrium conditions). The brine chemical environment is outlined in terms of brine chemistry, corrosion, and compositions. The nuclear radiation environment emphasized in this report is the stored energy that can be released as a result of radiation damage or crystal dislocations within crystal lattices.

33328 (RFP—3110) **US Department of Energy acceptance of commercial transuranic waste.** Taboas, A.L.; Bennett, W.S.; Brown, C.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Feb 1980. Contract AC04-76DP03533. 27p. NTIS, PC A03/MF A01.

Contaminated transuranic wastes generated as a result of nondefense activities have been disposed of by shallow land burial at a commercially operated (NECO) facility located on the Hanford federal reservation, which is licensed by the State of Washington and by the NRC. About 15,000 ft^3 of commercial TRU waste have been generated each year, but generation for the next three years could triple due to decontamination and decommissioning scheduled to start in 1980. Disposal at other commercial burial sites has been precluded due to sites closing or prohibitions on acceptance of transuranic wastes. The State of Washington recently modified the NECO-Hanford operating license, effective February 29, 1980, to provide that radioactive wastes contaminated with transuranics in excess of 10 nCi/g will not be accepted for disposal. Consistent with the state policy, the NRC amended the NECO special nuclear material license so that Pu in excess of 10n Ci/g cannot be accepted after February 29, 1980. As a result, NRC requested DOE to examine the feasibility of accepting these wastes at a DOE operated site. TRU wastes accepted by the DOE would be placed in retrievable storage in accordance with DOE policy which requires retrievable storage of transuranic wastes pending final disposition in a geologic repository. DOE transuranic wastes are stored at six major DOE sites: INEL, Hanford, LASL, NTS, ORNL, and SRP. A specific site for receiving commercial TRU waste has not yet been selected. Shipments to DOE-Hanford would cause the least disruption to past practices. Commercial TRU wastes would be subject to waste form and packaging criteria established by the DOE. The waste generators would be expected to incur all applicable costs for DOE to take ownership of the waste, and provide storage, processing, and repository disposal. The 1980 charge to generators for DOE acceptance of commercial TRU waste is $147 per cubic foot.

33329 (RHO-BWI-CD—35) **Nuclear waste repository in basalt project B-301 preconceptual design report.** (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Feb 1980. Contract AC06-77RL01030. 730p. NTIS, PC A99/MF A01.

The functions and design requirements are consistent with the DOE initially approved functional design criteria. The reference preconceptual design meets the initially approved criteria with two significant exceptions. Codes, standards, and regulations governing the design are summarized. Many design criteria are yet to be determined. Documentation regarding the nuclear waste forecast used (namely 380 GWe in the year 2000) is presented. This forecast provides a conservative basis for repository sizing, budgeting, risk assessment, and license planning during the early design stages and was used in preference to more recent forecasts. Each part of the report is presented in terms of the preconceptual waste breakdown structure (WBS) elements so that the schedules and cost estimates correlate with the design descriptions. The preconceptual WBS used is presented. The WBS will be modified and expanded during the conceptual design, consistent with the heirarchy of physical elements, project phases, organizational responsibilities, and funding categories. The WBS and its further expansions will govern the development of the system design description, project schedule, and cost estimate. Designs are available for nuclear waste repositiories in several geologic mediums in the United States and elsewhere. To assure maximum technology transfer, designs and criteria for these other repositories have been reviewed. Key design parameters for a repository in basalt are compared with those for repositories in other geologic media. Repositories in different geologic media differ primarily in their subsurface features. Consequently, design emphasis was placed on the shafts, subsurface facilities, and subsurface systems. Rock mechanics and trade studies are included, documenting significant subsurface design features, alternatives considered.

33330 (SAND—79-0284) **Basic data report for drillhole WIPP 30 (Waste Isolation Pilot Plant - WIPP).** (Sandia National Labs., Albuquerque, NM (USA)). Apr 1980. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01.

WIPP 30 was drilled in east-central Eddy County, New Mexico, in NW 1/4, Sec. 33, T21S, R31E, to obtain drill core for the study of dissolution of near-surface rocks. The borehole encountered from top to bottom, the Dewey Lake Red Beds (449′ including artificial fill for drill pad), Rustler Formation (299′), and the upper 160′ of the Salado Formation. Continuous core was cut from the surface to total depth. Geophysical logs were taken the full length of the borehole to measure acoustic velocities, density, and distribution of potassium and other radioactive elements. Information from this borehole will be included in an interpretive report on dissolution in Nash Draw based on combined borehole data, surface mapping and laboratory analyses of rocks and fluids. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes and to then be converted to a repository. The WIPP will also provide research facilities for interactions between high-level waste and salt. Administration policy as of February 1980 is to hold the WIPP site in reserve until the first disposal site can be chosen from several potential sites, including the WIPP.

33331 (SAND—79-0377) **Borehole-inclusion stressmeter measurements in bedded salt.** Cook, C.W.; Ames, E.S. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

Sandia purchased borehole-inclusion stressmeters from a commercial supplier to measure in situ stress changes in bedded salt. However, the supplied stressmeters were difficult to set in place and gave erratic results in bedded salt. These problems were overcome with a new extended platen design. Also a straingaged transducer was designed which can be read with a conventional data logger. Due to the nonlinear behavior of bedded salt under uniaxial loading, a new empirical calibration scheme was devised. In essence, the stressmeters are calibrated as force transducers and this calibration curve is then used to determine the relationship between uniaxial stress changes in bedded salt and the gage's output. The stressmeter and calibration procedures have been applied under mine conditions and produced viable results. Future work will involve finite element analysis to calculate the observed behavior of the stressmeters. The response of the stressmeters in bedded salt is neither that of a true stressmeter or of a true strainmeter. However, repeatable calibrations make the gages very useful.

33332 (SAND—79-1110) **Radionuclide sorption and migration studies of getters for backfill barriers.** Nowak, E.J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01.

Bentonite and hectorite clay minerals were chosen for study and development as potential backfill materials for testing in the proposed Waste Isolation Pilot Plant (WIPP), a radioactive waste repository and test facility in bedded salt. This choice of materials was based on initial screening results which are presented and on the predicted physical properties of these materials. These properties were verified experimentally in concentrated brines specific to the WIPP site. Distribution coefficients, K/sub d/, were calculated from batch sorption measurements on bentonite and hectorite in the nearly saturated brines A and B. The resulting K/sub d/ values were in the range of (1 to 5) x 10^3 ml/g for europium; (2 to 40) x 10^3 ml/g for plutonium(IV); and (4 to 16) x 10^3 ml/g for americium(III). A silica- and calcite-containing sand mixed with bentonite and hectorite acted as a sorber of americium(III) but was merely an inert diluent for plutonium(IV). Pertechnetate anions (TcO_4^-) sorbed on activated charcoal with K/sub d/ values in the range of (0.2 to 0.4) x 10^3 ml/g. Pertechnetate, cesium, and strontium ions in brine were not sorbed appreciably by bentonite or hectorite. Although experimental evidence is given for a possible role of solubility in the sorption of europium on getters, other data presented here and evidence from the literature are inconsistent with a simple single reaction sorption mechanism. It is concluded that a backfill containing bentonite on hectorite and activated charcoal is potentially an effective barrier to the migration of Eu(III), Pu(IV), and Am(III) cations and, with further development, to the migration of TcO_4^- anions as well.

33333 (SAND—79-1276) **In-situ tuff water migration/heater experiment: experimental plan.** Johnstone, J.K. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 166p. NTIS, PC A08/MF A01.

Tuffs on the Nevada Test Site (NTS) are currently under investigation as a potential isolation medium for heat-producing nuclear wastes. The National Academy of Sciences has concurred in our identification of the potentially large water content ($\leqq$ 40 vol %) of tuffs as one of the important issues affecting their suitability for a repository. This Experimental Plan describes an in-situ experiment intended as an initial assessment of water generation/migration

in response to a thermal input. The experiment will be conducted in the Grouse Canyon Welded Tuff in Tunnel U12g (G-Tunnel) located in the north-central region of the NTS. While the Grouse Canyon Welded Tuff is not a potential repository medium, it has physical, thermal, and mechanical properties very similar to those tuffs currently under consideration and is accessible at depth (400 m below the surface) in an existing facility. Other goals of the experiment are to support computer-code and instrumentation development, and to measure in-situ thermal properties. The experimental array consists of a central electrical heater, 1.2 m long x 10.2 cm diameter, surrounded by three holes for measuring water-migration behavior, two holes for measuring temperature profiles, one hole for measuring thermally induced stress in the rock, and one hole perpendicular to the heater to measure displacement with a laser. This Experimental Plan describes the experimental objectives, the technical issues, the site, the experimental array, thermal and thermomechanical modeling results, the instrumentation, the data-acquisition system, posttest characterization, and the organizational details.

33334 (SAND—80-0312C) **Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste.** Hickox, C.E.; Gartling, D.K.; McVey, D.F.; Russo, A.J.; Nuttall, H.E. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). 1980. Contract AC04-76DP00789. 22p. (CONF-801020—2). NTIS, PC A02/MF A01.

From Marine technology conference; Washington, DC, USA (6 Oct 1980).

Portions of document are illegible.

A mathematical basis is developed for the prediction of thermal and radionuclide transport in marine sediments. The theory is applied to the study of radioactive waste disposal by emplacement, in specially designed containers, well below the sediment/water interface. Numerical results are obtained for a specified model problem through use of two computer programs designed primarily for the analysis of waste disposal problems. One program (MARIAH) provides descriptions of the temperature and velocity fields induced by the presence of a container of thermally active nuclear waste. A second program (IONMIG), which utilizes the results of the thermal analysis, is used to provide predictions for the migration of four representative radionuclides: ^{239}Pu, ^{137}Cs, ^{129}I, and ^{99}Tc.

33335 (SAND—80-1533C) **Thermophysical properties of deep ocean sediments.** Hadley, G.R.; McVey, D.F.; Morin, R. (Sandia National Labs., Albuquerque, NM (USA); Rhode Island Univ., Kingston (USA). Dept. of Ocean Engineering). 1980. Contract AC04-76DP00789. 12p. (CONF-801020—1). NTIS, PC A02/MF A01.

From Marine technology conference; Washington, DC, USA (6 Oct 1980).

Here we report measurements of the thermal conductivity and diffusivity of reconsolidated illite and smectite ocean sediments at a pore pressure of 600 bars and temperatures ranging from 25 to 420°C. The conductivity and diffusivity were found to be in the range of 0.8 to 1.0 W/m-K and 2.2 to 2.8 x 10^{-7} m^2/s, respectively. These data are consistent with a mixture model which predicts sediment thermal properties as a function of constituent properties and porosity. Comparison of pre- and post-test physical properties indicated a decrease in pore water content and an order of magnitude increase in shear strength and permeability.

33336 (SAND—80-1606C) **Overview of the Subseabed Disposal Program.** Anderson, D.R.; Boyer, D.G.; Hessler, R.R.; Hollister, C.D.; Talbert, D.M.; Yayanos, A.A. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-801020—3). NTIS, PC A02/MF A01.

From Marine technology conference; Washington, DC, USA (6 Oct 1980).

This presentation addresses the rationale, history, strategy, and management techniques used in the development of the US Subseabed Disposal Program (SDP) for both high level waste and spent fuel. The three subsections will summarize first, the US Department of Energy (DOE) high level waste and spent fuel waste disposal strategy and the position that the SDP occupies within that strategy; second, the technical and administrative tools developed to support the long range research and engineering plans defined by the DOE, program management, and program participants and employed to facilitate the day-to-day operation of the SDP; and third, the current studies and plans for addressing the legal, political, and international uncertainties that must be addressed before the SDP reaches the final engineering phases.

33337 (UCRL—52749) **Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt.** Steinborn, T.L.; Wagoner, J.L.; Qualheim, B.; Fitts, C.R.; Stetkar, R.E.; Turnbull, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 16 Jun 1980. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01.

Screening criteria and specifications are recommended to aid in the evaluation of sites proposed for nuclear waste disposal in basalt and domed salt. The recommended new criteria proposed in this report are intended to supplement existing repository-related criteria for nuclear waste disposal. The existing criteria are contained in 10 CFR 60 sections which define siting criteria of the Nuclear Regulatory Commission (NRC), and ONWI 33(2) which defines siting criteria of the Office of Nuclear Waste Isolation (ONWI) for the Department of Energy. The specifications are conditions or parameter values that the authors recommend be applied in site acceptance evaluations. The siting concerns covered in this report include repository depth, host rock extent, seismic setting, structural and tectonic conditions, groundwater and rock geochemistry, volcanism, surface and subsurface hydrology, and socioeconomic issues, such as natural resources, land use, and population distribution.

33338 (UCRL—84613) **Status of LLNL granite projects.** Ramspott, L.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 11p. (CONF-800751—3). NTIS, PC A02/MF A01.

From Workshop on thermomechanical-hydrochemical modeling for hardrock waste repository; Bereley, CA, USA (29 Jul 1980).

The status of LLNL Projects dealing with nuclear waste disposal in granitic rocks is reviewed. This review covers work done subsequent to the June 1979 Workshop on Thermomechanical Modeling for a Hardrock Waste Repository and is prepared for the July 1980 Workshop on Thermomechanical-Hydrochemical Modeling for a Hardrock Waste Repository. Topics reviewed include laboratory determination of thermal, mechanical, and transport properties of rocks at conditions simulating a deep geologic repository, and field testing at the Climax granitic stock at the USDOE Nevada Test Site.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33318, 34136, 34147

33339 (SAND—80-7107) **Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977.** Pocalujka, L.P.; Babij, E.; Catizone, P.A.; Church, H.W. (TRC Environmental Consultants, Wethersfield, CT (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 26p. NTIS, PC E02/MF $3.50.

The purpose of the WIPP meteorological, air quality, and radiological measurements program was to support the environmental effort for the evaluation of the site suitability. This data report is the latest in a series of seasonal quarterly data summaries to be issued for the southeastern New Mexico site.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 33318, 34136, 34188

33340 (DPSPU—79-30-19) **Decontamination and decorporation: the clinical experience.** Poda, G.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1979. Contract AC09-76SR00001. 9p. (CONF-791085—4). NTIS, PC A02/MF A01.

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

Decontamination and decorporation are quite interrelated when dealing with a contaminated person. Some clinical experiences from a transuranium production facility are offered. Skin decontamination is accomplished by washing with detergent and water. Stubborn cases are treated with sodium hypochlorite followed by rinsing, and emery cloth is used on more stubborn nail or finger pad contamination. If inhaled, the usual skin cleansing followed by nasal douche with normal saline decontaminates reachable areas and one of the DTPA salts given via aerosol both decontaminates and decorporates the inner recesses. Saline laxative reduces the time inhaled, and ingested particles remain in the gastro-intestinal tract. Conservatism prevails in general, but most persons found to have inhaled contamination are given a single chelation within the hour of discovery and if subsequently found to have over 10% M.P.P.B. of a soluble actinide are offered further chelation. Single dose chelation has been found to be relatively innocuous and usually sufficient. The longest case of chelation therapy spanned 2-1/4 years and encompassed 123 doses of CaNa-DTPA.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

33341 (AGNS—35900-Conf-85) **Potential for meeting IAEA safeguards goals for reprocessing.** Bambas, K.J. (Allied-General Nu-

clear Services, Barnwell, SC (USA)). Sep 1980. Contract AC09-78ET35900. 12p. (CONF-800938—1). NTIS, PC A02/MF A01.

From International executive conference on nonproliferation and safeguards; Mexico City, Mexico (7 Sep 1980).

The author concludes that: Safeguards which allow the meeting of IAEA uranium and plutonium diversion detection goals for large-scale reprocessing plants are achievable. Concepts exists for ways in which IAEA inspectors could verify data received from operations of such facilities. Additional work is needed, particularly in the futher development of on-line instruments. Computerized near real-time accounting systems may provide significant operational benefits in addition to being required for safeguards purposes.

33342 (LA—8313-M) **DYMAC digital electronic balance.** Stephens, M.M. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01.

The Dynamic Materials Accountability (DYMAC) System at LASL integrates nondestructive assay (NDA) instruments with interactive data-processing equipment to provide near-real-time accountability of the nuclear material in the LASL Plutonium Processing Facility. The most widely used NDA instrument in the system is the DYMAC digital electronic balance. The DYMAC balance is a commercial instrument that has been modified at LASL for weighing material in gloveboxes and for transmitting the weight data directly to a central computer. This manual describes the balance components, details the LASL modifications, reviews a DYMAC measurement control program that monitors balance performance, and provides instructions for balance operation and maintenance.

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

33343 (UCRL—83398) **Surface treatment of lead glass microsphere.** Andrews, J.E. Jr.; Koo, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 May 1980. Contract W-7405-ENG-48. 9p. (CONF-800208—15). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

The structural arrangement of a hydrated glass surface depends on the composition, thermal history and surface treatment. This paper considers the surface treatment of a lead glass with weak and strong acid solutions and in particular hydrogen peroxide, to give a microscopically clean microsphere.

33344 (UCRL—83399) **Fusion microsphere targets.** Koo, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jul 1980. Contract W-7405-ENG-48. 6p. (CONF-800208—16). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

It was shown that a microsphere within the structure limitations is hydrodynamically stable. To insure its perfect formation, the initial chemical compositions must have a blowing capability, more important, the resultant liquid compositions must also have sufficient surface tension and low viscosity.

33345 Process for manufacture of inertial confinement fusion targets and resulting product. Solomon, D.E.; Wise, K.D.; Wuttke, G.H.; Masnari, N.A.; Rensel, W.B.; Robinson, M.G. (to KMS Fusion, Inc., Ann Arbor, MI (USA)). British Patent 2,025,683/A/. 23 Jan 1980. 5p.

A method of manufacturing inertial confinement fusion targets is described which is adaptable for high volume production of low cost targets in a wide variety of sizes. The targets include a spherical pellet of fusion fuel surrounded by a protective concentric shell.

PROPERTIES

33346 Dielectric constant and electrical conductivity of liquid D-T. Souers, P.C.; Fearon, E.M.; Iwamiya, J.H.; Roberts, P.E.; Tsugawa, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Cryogenics;* **20**: No. 5, 247-251(May 1980).

The first dielectric constant and electrical conductivity measurements on liquid deuterium-tritium are reported. The samples, which contain 0.9, 8.8, and 98.3% tritium, are measured for complex capacitance at 1592 Hz with an effective electric field of 2830 Vm^{-1} at temperatures of 20 to 26 K. The tritium radioactivity converts the samples dielectrics, with dielectric constants as large as 4.5 and electrical conductivities of 200 x 10^{-9} $(\Omega\ m)^{-1}$. Carrier densities are about 10^{10} per mol sample; both free electrons and ions are apparently present.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

33347 (K/OA—4748) **Gas flow in a centrifuge.** Berger, M.H. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Jun 1980. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

The mathematical relationship between Onsager's pancake equation and the Ekman boundary layer equations is derived by methods of perturbation theory. The so-called internal flow region is shown to be simply the first term in an asymptotic series for the outer expansion. The complementary inner expansion is shown to be the Ekman layer. Some of the more subtle approximations and assumptions on boundary conditions are given attention.

RADIATION SOURCES

OTHER INDUSTRIAL USES

33348 (SAND—80-7097) **Irradiation of sewage sludge using cesium-137: a comparative assessment.** (CH2M Hill Central, Inc., Boise, ID (USA)). Jun 1980. Contract AC04-76DP00789. 173p. NTIS, PC A08/MF A01.

Irradiation using ^{137}CS is a recently developed process for disinfecting sewage sludge before applying it to the land. Irradiation, composting, and heat drying are Processes to Further Reduce Pathogens (PFRP) when operated to meet the guidelines set forth under Title 40, Code of the Federal Register, Part 257 (40 CFR 257). This report identifies and develops technical, operational, and environmental considerations for sludge handling systems incorporating these PFRP to determine the economic advantages of each process. The results indicate that sludge irradiation systems are cost-competitive with composting and heat drying systems for wastewater treatment plants with or without existing anaerobic digesters. Irradiation can thus be considered for new as well as upgrading existing facilities for sludge disinfection. An attractive aspect of the irradiation process is that significantly less conventional energy is used for operation when compared to composting and heat drying. In the final analysis, however, the applicability and desirability of any process is best determined by more evaluations specific to a given community.

ISOTOPIC POWER SUPPLIES

33349 (LA—8454-PR) **General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01.

This formal monthly report covers the studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The two programs involved are the following: General-Purpose Heat Source Development; and Space Nuclear Safety and Fuels. Most of the studies discussed here are of a continuing nature. Results and conclusions described may change as the work continues.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 33202

33350 (DOE/JPL—955492(Vol.2)(Pt.1)) **Solar/hydrogen systems technologies. Volume II (Part 1 of 2). Solar/hydrogen systems assessment. Final report.** Escher, W.J.D.; Foster, R.W.; Tison, R.R.; Hanson, J.A. (Escher Technology Associates, St. Johns, MI (USA)). 2 Jun 1980. Contract ET-78-I-01-3112. 279p. NTIS, PC A13/MF A01.

Volume II of the Solar/Hydrogen Systems Assessment contract report (2 volumes) is basically a technological source book. Relying heavily on expert contributions, it comprehensively reviews

constituent technologies from which can be assembled a wide range of specific solar/hydrogen systems. Covered here are both direct and indirect solar energy conversion technologies; respectively, those that utilize solar radiant energy input directly and immediately, and those that absorb energy from a physical intermediary, previously energized by the sun. Solar-operated hydrogen energy production technologies are also covered in the report. The single most prominent of these is water electrolysis. Utilization of solar-produced hydrogen is outside the scope of the volume. However, the important hydrogen delivery step is treated under the delivery sub-steps of hydrogen transmission, distribution and storage. An exemplary use of the presented information is in the synthesis and analysis of those solar/hydrogen system candidates documented in the report's Volume I. Morever, it is intended that broad use be made of this technology information in the implementation of future solar/hydrogen systems. Such systems, configured on either a distributed or a central-plant basis, or both, may well be of major significance in effecting an ultimate transition to renewable energy systems.

33351 (DOE/JPL—955492(Vol.2)(Pt.2)) **Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report.** Escher, W.J.D.; Foster, R.W.; Tison, R.R.; Hanson, J.A. (Escher Technology Associates, St. Johns, MI (USA)). 2 Jun 1980. Contract ET-78-I-01-3112. 237p. NTIS, PC A11/MF A01.

Volume II of the Solar/Hydrogen Systems Assessment contract report (2 volumes) is basically a technological source book. Relying heavily on expert contributions, it comprehensively reviews constituent technologies from which can be assembled a wide range of specific solar/hydrogen systems. Covered here are both direct and indirect solar energy conversion technologies; respectively, those that utilize solar radiant energy input directly and immediately, and those that absorb energy from a physical intermediary, previously energized by the sun. Solar-operated hydrogen energy production technologies are also covered in the report. The single most prominent of these is water electrolysis. Utilization of solar-produced hydrogen is outside the scope of the volume. However, the important hydrogen delivery step is treated under the delivery sub-steps of hydrogen transmission, distribution and storage. An exemplary use of the presented information is in the synthesis and analysis of those solar/hydrogen system candidates documented in the report's Volume I. Moreover, it is intended that broad use be made of this technology information in the implementation of future solar/hydrogen systems. Such systems, configured on either a distributed or a central-plant basis, or both, may well be a major significance in effecting an ultimate transition to renewable energy systems.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 33195

33352 (BNL—51226) **Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979.** (Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 119p. NTIS, PC A06/MF A01.

The progress made in 1979 in the Chemical/Hydrogen Energy Storage Systems Program is described. The program is managed by Brookhaven National Laboratory for the Division of Energy Storage Systems of the Department of Energy. The program consists of research and development activities in the areas of Hydrogen Production, Storage and Materials, End-Use Applications/Systems Studies, and in Chemical Heat Pumps. The report outlines the progress made by key industrial contractors such as General Electric in the development of SPE water electrolyzers; INCO in the studies of surface poisoning (and reactivation) of metal hydrides; and Air Products and Chemicals in the evaluation of hydrogen production at small hydropower sites. The BNL in-house supporting research, as well as that at universities and other national laboratories for which BNL has technical oversight, is also described.

33353 (DOE/JPL—955492(Vol.1)) **Solar/hydrogen systems for the 1985 to 2000 time frame. Volume I. Solar/hydrogen systems assessment. Final report.** Foster, R.W.; Tison, R.R.; Escher, W.J.D.; Hanson, J.A. (Escher Technology Associates, St. Johns, MI (USA)). 1 Jun 1980. Contract ET-78-I-01-3112. 147p. NTIS, PC A07/MF A01.

The findings of a study of opportunities for commercialization of systems capable of producing hydrogen from solar energy are presented in two volumes. A compendium of monographs by specialists in the fields of solar energy conversion technologies, hydrogen production technologies and related technology descriptions from the general literature comprise Volume II. This data base was used to support an evaluation and selection process that identified four candidate solar/hydrogen systems best suited to commercialization within the next two decades. Volume I first reviews the background of the work and the methods used. Then an evaluation of the hydrogen product costs that might be achieved by the four selected candidate systems (photovoltaic/water electrolysis, thermal-heat engine/water electrolysis, wind energy/water electrolysis, small hydrogen/water electrolysis) is compared with the pricing structure and practices of the commodity gas market. Subsequently, product cost and market price match is noted to exist in the small user sector of the hydrogen marketplace. Barriers to and historical time lags in, commercialization of new technologies are then reviewed. Finally, recommendations for development and demonstration programs designed to accelerate the commercialization of the candidate systems are presented.

THERMOCHEMICAL PROCESSES

33354 (GA-A—15935) **Preliminary results from bench-scale testing of a sulfur-iodine thermochemical water-splitting cycle.** O'Keefe, D.; Allen, C.; Besenbruch, G.; McCorkle, K.; Norman, J.; Sharp, R. (New Mexico State Univ., Las Cruces (USA); General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AC02-80ET26225. 45p. (CONF-801028—1). NTIS, PC A03/MF A01.

From 20. joint AICHE-IMIQ meeting; Acapulco, Mexico (15 Oct 1980).

Portions of a bench-scale model of a sulfur-iodine thermochemical water-splitting cycle have been operated at General Atomic Company as part of a comprehensive program to demonstrate the technology for hydrogen production from nonfossil sources. The hydrogen program is funded by the US Department of Energy, the Gas Research Institute, and General Atomic Company. The bench-scale model consists of three subunits which can be operated separately or together and is capable of producing as much as 4 std liters/min (6.7×10^{-5} m^3/s at standard conditions) of gaseous hydrogen. One subunit (main solution reaction) reacts liquid water, liquid iodine (I_2) and gaseous sulfur dioxide (SO_2) to form two separable liquid phases: 50 wt % sulfuric acid (H_2SO_4) and a solution of iodine in hydriodic acid (HI/sub x/). Another subunit (H_2SO_4 concentration and decomposition) concentrates the H_2SO_4 phase to the azeotropic composition, then decomposes it at high temperature over a catalyst to form gaseous SO_2 and oxygen. The third subunit (HI separation and decomposition) separates the HI from water and I_2 by extractive distillation with phosphoric acid (H_3PO_4) and decomposes the HI in the vapor phase over a catalyst to form I_2 and product hydrogen. This paper presents the results of on-going parametric studies to determine the operating characteristics, performance, and capacity limitations of major components.

33355 (LA-UR—80-2400) **LASL thermochemical hydrogen program status on September 30, 1980.** Cox, K.E.; Peterson, C.L.; Jones, W.M.; Bowman, M.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801047—1). NTIS, PC A02/MF A01.

From Annual contractors review meeting for the Department of Energy's Office of Advanced Conservation Technologies; Washington, DC, USA (13 Oct 1980).

The work described here was accomplished during the period October 1, 1979-September 30, 1980. Highlights of the experimental program were: a solids decomposition facility was constructed and used to study the handling of bismuth oxysulfates and the kinetics of their decomposition; and the results of our kiln experiments showed that a substantial amount of bismuth oxysulfate decomposition occurs with residence times under 2 min. at temperatures between 973 and 1143°K. The LASL bismuth sulfate sub-cycle thus appears a candidate for hydrogen production utilizing a solar heat source. In the evaluation phase of our work, the technoeconomics of the hybrid sulfur cycle were determined and compared with several published results as well as compared to the technoeconomics for water electrolysis processes for hydrogen production. We aided the efforts of the Department of Energy (DOE) Thermochemical Cycle Evaluation Panel in reviewing the Lawrence Livermore Laboratory (LLL) zinc selenide cycle as well as the General Atomic (GA) sulfur-iodine cycle.

STORAGE

REFER ALSO TO CITATION(S) 33350, 33351, 33352

CHEMISORPTION

REFER ALSO TO CITATION(S) 33866, 33874, 33885

TRANSPORT

REFER ALSO TO CITATION(S) 33350, 33351

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 33352

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

PREPARATION

33356 Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas. Guth, E.D.; Daly, L.A.; Arand, J.K. US Patent 4,166,830. 4 Sep 1979. Filed date 21 Jun 1978. 22p.

A continuous process is described for the selective production of ethylene by the diacritic cracking of heavy hydrocarbon feeds such as residual oils, heavy vacuum gas oils, atmospheric gas oils, crude oils and coal-derived liquids. The diacritic cracking takes place in a non-tubular multi-zone reactor at elevated pressures (e.g. 70 to 1000 psia). A fuel is combusted with oxygen in the first section of the multi-zone reactor. The high temperature products of combustion of the first zone pass into a second section of the reactor where the feed is atomized and cracked to yield products including ethylene, acetylene and synthesis gas. The reaction products of the second zone then pass into a third section in which they are quenched. In each stage of the reactor the present process seeks to prevent the build-up of coke deposits on the walls of the reactor. In the first two stages, a film of gas such as CO_2 or N_2 is injected along the inner walls to prevent build-up of coke. In the quench section the liquid material introduced as the quenching fluid also acts as a barrier to prevent coking. 2 figures.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 33934

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 33418, 33425, 33426, 33427, 33428, 33429, 33431

33357 Conversion of urban refuse to substitute natural gas by the Biogas Process. Ghosh, S.; Klass, D.L. Chicago, IL; Institute of Gas Technology (1974). 16p. (CONF-740599—2).

From 4. mineral waste utilization symposium; Chicago, IL, USA (7 May 1974).

The Institute of Gas Technology (IGT) recognized the need and utility of a comprehensive waste-management system several years ago, and undertook the development of such a process in cooperation with the City of Indianapolis, Indiana, the Citizens Gas and Coke Utility, Indianapolis, Indiana, and private agencies working in the areas of resource recovery and the manufacture of waste processing equipment. This paper presents a summary of part of the work completed at IGT on the development of processing systems which are capable of simultaneous conversion of wastes to SNG and disposable stabilized residue, and of recovering the mineral resources present in these wastes. Although this paper is concerned primarily with the disposal and gasification of municipal refuse-sludge blends, the overall objective of IGT's work has been to develop processes applicable to a broad range of organic wastes.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 33417, 34111

PROPERTIES

REFER ALSO TO CITATION(S) 33840, 33841, 33842, 33843, 33844, 33845, 33846, 33847, 33848

33358 (CONF-790520—, pp I.12.1-I.12.10) **Modeling of flame properties of methanol.** Westbrook, C.K. (Univ. of California, Livermore); Dryer, F.L. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

The detailed reaction mechanism and flame model have been used to predict various properties of methanol-air laminar flames. The predicted values agree well with experimentally determined properties in those cases where data are available, and the preicted trends are consistent with measured data for other fuels in those cases where methanol-air flame data are not available. It is important to emphasize that this is a purely predictive study, with no adjustments made to reaction rate data or transport properties to improve agreement with experiment. The model prediction of the pressure dependence of flame speed and structure has shown that the increased dependence of flame speed on pressure above 1 atmosphere is due to competition between radical recombination reactions and chain branching reactions. This result provides a detailed interpretation of a great deal of experimental flame speed data for methanol-air flames and for methane-air flames as well. From the point of view of practical applications for the model, the excellent agreement between these calculated flame parameters and previously measured data indicate that the model is correctly predicting most of the significant properties of these flames. As a result it should be expected that the model could be used reliably in the interpretation of most methanol-air experimental data and as a practical aid in a design capacity.

33359 (CONF-790520—, pp II.22.1-II.22.14) **Physical properties of gasoline/alcohol automotive fuels.** Cox, F.W. (Dept. of Energy, Bartlesville, OK). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

Non-petroleum derived alcohols are likely candidates for near-future use of alternative automotive fuels. Low molecular weight alcohols may be used alone or in combination with gasoline, but either usage presents its own unique set of advantages and disadvantages. This report addresses the physical property changes (both beneficial and detrimental) which occur when alcohols are added to gasoline as fuel extenders. The experimental data and discussion of results cover four physical property areas: water tolerance, vapor pressure, distillation characteristics, and octane quality. The alcohols include methanol, ethanol, n-propanol, i-butanol, and synthetic methyl fuel. Several additional alcohols were tested, but only as gasoline/methanol cosolvents. The major objective of the physical properties study was to determine the interdependency among the variables which are responsible for the significant property changes so that, where possible, gasoline/alcohol properties can be estimated from blend composition. Trends are also discussed in terms of the general influences of system variables.

PREPARATION

33360 Alcohol Fuels Task Force. Final report to the Oregon Alternate Energy Development Commission. Salem, OR; Oregon Department of Energy (1980). 70p. (NP—25024).

Oregonians are producing small amounts of fuel alcohol on farms now and the number will probably increase. Feasibility studies are proposed for large-scale alcohol-production facilities in Oregon. The Federal Bureau of Alcohol, Tobacco, and Firearms (BATF) experimental permits are being granted at a faster pace and the experimental production bonds are being no longer required. Public awareness of realistic potentials for fuel alcohol is growing daily. Oregonians should be advised that the manufacture of fuel alcohol greater than 190 proof is very difficult to accomplish with a one-pass still or with a pot-type still. There are many new products for alcohol-fuel production being sold in Oregon for the do-it-yourself person. The public should check all claims of the manufacturers of such products carefully before purchase. Development of technology for alcohol-fuel production, pending Federal legislation and future foreign developments will greatly influence the rate of alcohol production. Oregon can realistically expect to have in excess of five million gallons of fuel alcohol available by 1985. The Task Force members believe the benefits of fuel-alcohol production and use are: reduction of foreign fossil-fuel imports; improvement in Oregon's economic performance; improvement in making the Oregon farmer more energy self-sufficient. The present state-of-the-art of fuel alcohol production in Oregon is summarized.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 33362

33361 (DOE/ET/14858—2) **Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. Second quarterly progress report, January 1-March 31, 1980.** (Chem Systems, Inc., Fairfield, NJ (USA)). 15 Aug 1980. Contract AC22-79ET14858. 77p. NTIS, PC A05/MF A01.

Nineteen catalysts were prepared by either (a) evaporation of metal nitrate-citric acid solutions; (b) coprecipitation of nitrates with carbonates; (c) mechanical blending of the metal oxide (or nitrate) powders or (d) modification of commercial methanol synthesis catalysts. Fourteen catalysts were tested in either the Berty gradientless reactor or the plug-flow reactor. Previously reported selectivities to liquid products were determined with a more refined gas chromatographic system, show that C_1-C_9 HC were also present in the liquid product in addition to the alcohols. A sample of liquid product recovered from a 100 hour test made with a $CuZn_{0.125}CrCoK_{0.11}$ catalyst was analyzed by GC and found to contain 55.9 wt % C_1-C_6 linear alcohols, 33.0% C_1-C_7 aldehydes, 9.2% C_5-C_9 paraffins and 1.9% unidentified oxygenates. A preliminary techno-economic assessment of three potential synthesis reactor systems - liquid-fluidized, multi-tube, jacketed fixed-bed or adiabatic fixed-bed - was

made which indicated that there are significant captial cost and operating cost savings associated with the use of a liquid-fluidized reactor system.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 33415, 33416, 33419, 33428, 33429, 33430

33362 (CONF-790520—, pp II.37.1-II.37.12) **Comparative economic analysis of alcohol fuels production options.** Jones, J.L.; Barkhordar, P.M.; Bomberger, D.C. (SRI International, Menlo Park, CA). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

The principal objective of the SRI study for the DOE alcohol Policy Review was to prepare a comparative economic analysis of alternative alcohol fuel producttion technologies from a variety of feedstocks using a consistent set of design and economic bases. The technologies considered in the study ranged from commercially available process to conceptual process being developed in laboratory scale equipment. The feedstocks considered ranged from those now readily available, such as bituminous coal, lignite, municipal solid waste, and sugar cane, to those that are not now items of commercial trade, such as corn stover and wheat straw. The capacity of alcohol fuel production plants was specified based on consideration of feedstock availability and conversion plant economies of scale. The study illustrated the effect on alcohol fuel price of variations in conversion plant production capacity, feedstock cost, by-product credits, financing, and rate of return requirements.

33363 (CONF-790520—, pp II.41.1-II.41.12) **Production of methanol from wood.** Kohan, S.M. (SRI International, Menlo Park, CA). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

This paper discusses the technology and economics of producing methanol from wood. Comparisons are made to prior work in the field, including the production of methanol from coal and from municipal solid waste.

INORGANIC HYDROGEN COMPOUND FUELS

PREPARATION

33364 **Process for hydrogen recovery from ammonia purge gases.** Graham, T.E.; MacLean, D.L. (to Monsanto Co.). US Patent 4,180,552. 25 Dec 1979. Filed date 20 Mar 1978. 22p.

Ammonia synthesis processes are disclosed which provide enhanced recovery of hydrogen from ammonia synthesis purge streams by selective permeation. The enhanced recovery of hydrogen can provide increased conversion of hydrogen values to ammonia. In the processes, a purge stream from an ammonia synthesis loop at a superatmospheric pressure is passed to at least two permeator stages in series. Each permeator stage contains a separation membrane which exhibits selective permeation of hydrogen as compared to the permeation of each of methane and argon. A total pressure differential is maintained across the thickness of the separation membrane to provide a driving force for the permeation of hydrogen across the separation membrane of each of the permeator stages. Hydrogen permeates through the membrane, and a hydrogen-rich permeating gas is obtained on a permeate exit side of each of the permeator stages. The permeating gas from each of the permeator stages is recycled to the ammonia synthesis reaction zone. Between permeator stages, the non-permeating gas from one permeator stage is passed to the feed side of the next permeator stage. 5 figures.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 33429, 33815, 34116

33365 (NP—25083) **Wood waste for energy study: executive summary.** Bergvall, J.A.; Gee, L.; Koss, W. (Washington State Dept. of Natural Resources, Olympia (USA)). 1 Jan 1979. 16p. NTIS.

The study on wood wastes in Washington is divided into four segments - literature review, inventory assessment, economic analysis, and executive summary. The literature review abstracted about 1000 articles; the inventory analysis assessed and quantitied Washington's forest residues, wood-processing wastes, municipal solid wastes, agricultural wastes, and peat resources. The economic analysis considered making various residue harvest/production operations feasible, growing fiber for energy production, and the economics of forest lands. The executive summary briefly summarizes the most important findings of the inventory and economic analysis components and identifies the potential role that wood waste could play in the production of energy in Washington.

33366 (NP—25084) **Wood waste for energy study: inventory assessment and economic analysis.** Bergvall, J.A.; Bullington, D.C.; Gee, L.; Koss, W. (Washington State Dept. of Natural Resources, Olympia (USA)). 1 Sep 1978. 227p. NTIS.

The study is a four-segment report to supply basic information about wood residue as a potential energy source in Washington State. Segment 1 comprised a literature review about forest and mill residues as energy resources. This report, combining the second and third segments, consists of an inventory and an economic analysis. It quantifies Washington's residue availability, analyzes the cost of residue removal, and discusses the economic conditions that must occur to make wood a viable energy alternative. It includes a look at new products being developed to use forest residue, forest management problems created or eliminated by residue removal and use, forms of energy and chemical available from residue, and products originating from residue that would directly supplement energy supplies. The availability of forest residues, wood processing wastes, municipal solid wastes, agricultural wastes, and peat resources in Washington is assessed. There are also coal reserves, geothermal potential, undeveloped hydropotential, as well as potential for development of solar power, wind power, tidal, and wave energy in addition to nuclear power.

LIQUID WASTE FUELS

REFER ALSO TO CITATION(S) 33432

HYDRO ENERGY

HYDRO ENERGY

REFER ALSO TO CITATION(S) 33350, 33351, 33353

33367 **Hydro Task Force. Final report to the Oregon Alternate Energy Development Commission.** Salem, OR; Oregon Department of Energy (1980). 63p. (NP—25023).

Water power provides about 80% of the electricity generated in Oregon. Most of this power is produced at large multi-purpose dams on the Columbia River system and distributed through a regional transmission network. During the period when the Columbia was being harnessed, many smaller dams were built. Some of the resulting reservoirs provided domestic water supplies, irrigation, and impounded water for log ponds. Today, many of these sites and others are being re-assessed for environmentally acceptable, economically feasible power sites. The Task Force, relying on many sources, calculated that Oregon's gross undeveloped hydro power potential is 9000 MW. However, because of environmental and economic constraints, it is not expected that this potential will ever be fully realized. The Task Force concluded that a realistic estimate of the new installed capacity that Oregon's streams could support is about 1243 MW, representing production of about 410 average MW. For comparison, Bonneville Dam, before completion of the new powerhouse, has an installed capacity of 518 MW and annually produces 552 average MW. The Task Force recommendations place particular emphasis on measures that can be implemented to encourage small, backyard hydro facilities.

RESOURCES AND AVAILABILITY

33368 (BNL—51092) **Macroeconomic effects of accelerated implementation of renewable energy technologies in the US.** Marcuse, W.; Groncki, P.J. (Brookhaven National Lab., Upton, NY (USA)). Feb 1980. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01.

The original formulation of the Brookhaven energy system models was directed toward technology assessment for new and competing energy technologies. The Hudson-Jorgenson econometric model was originally formulated to identify the economic impacts of energy futures where energy-use projections departed markedly from historical trends. The two models were married so that the feedback effects of energy and nonenergy demand levels and nonenergy prices generated by the economic model could be reflected in the technology and fuel-mix-selection solutions of the energy model. In turn, the engineering-based energy costs, energy prices, and capital requirements for energy systems characterized in the energy model are used to override the econometric estimates based on historical data in the economic model. Recently, the coupled models have been used to address questions concerning the macroeconomic impacts of accelerating the implementation of renewable energy

technologies in the United States. Of particular interest were the scenarios where (1) renewables were included which cost more than conventional alternatives now and in the future, and (2) some renewables that are initially more costly are characterized by a learning curve so that in time their costs come to equal conventional alternatives. A further analysis was done for the first case (renewables always more expensive) under conditions where (1) the incremental costs were paid by the government through deficit financing, and (2) the incremental costs were paid by consumers. This paper presents the formulation of the analysis using the combined energy system - economic model and the results of the study.

33369 (DOE/RA/11025—T1(Vol.1)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 241p. NTIS, PC A11/MF A01.

The preliminary inventory and analysis procedures provide a comprehensive assessment of the undeveloped hydroelectric power potential in the US and determines which sites merit more thorough investigation. Over 5400 existing structures have been identified as having the physical potential to add hydropower plants or increase hydropower output thereby increasing our present hydropower capacity from a total of 64,000 MW to 158,000 MW and our energy from 280,000 GWH to 503,000 GWH. While the physical potential for this increase is clearly available, some of these projects will undoubtedly not satisfy more-detailed economic analysis as well as the institutional and environmental criteria which will be imposed upon them. Summary tables include estimates of the potential capacity and energy at each site in the inventory. In some cases, individual projects may be site alternatives to others in the same general location, when only one can be considered for hydropower development. The number of sites per state is identified, but specific information is included for only the sites in Alaska, Idaho, Oregon, and Washington in this first volume.

33370 (DOE/RA/11025—T1(Vol.2)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 132p. NTIS, PC A07/MF A01.

The estimates of existing, incremental, and the undeveloped hydropower potential for all states in the various regions of the country are presented. In the Pacific Southwest region, the maximum physical potential for all sites exceeds 33,000 MW of capacity with an estimated average annual energy greater than 85,000 GWH. By comparison, these values represent about 6% of the total potential capacity and hydroelectric energy generation estimated for the entire US. Of the total capacity estimated for the region, 9900 MW has been installed. The remainder (23,200 MW) is the maximum which could be developed by upgrading and expanding existing projects (6000 MW) and by installing new hydroelectric power capacity at all potentially feasible, undeveloped sites (17,200 MW). Small-scale facilities account for less than 4% of the region's total installed capacity, but another 600 MW could be added to these and other small water resource projects. In addition, 600 MW could be installed at potentially feasible, undeveloped small-scale sites. The small-scale resource varies considerably, with the states of California and Utah having the largest potential for incremental development at existing projects in the Pacific Southwest region. States comprising the Southwest are Arizona, California, Hawaii, Nevada, and Utah.

33371 (DOE/RA/11025—T1(Vol.3)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 229p. NTIS, PC A11/MF A01.

The US Corps of Engineers' assessment of the nation's hydroelectric resources provides a current and comprehensive estimate of the potential for incremental or new generation at existing dams and other water resource projects, as well as for undeveloped sites in the US. The demand for hydroelectric power is addressed and various related policy and technical considerations are investigated to determine the incentives, constraints, and impacts of developing hydropower to meet a portion of the future energy demands. The comprehensive data represent the effort of the Corps of Engineers based on site-specific analysis and evaluation. Summary tables include estimates of the potential capacity and energy at each site in the inventory. The number of sites and potential capacity in each state are identified, but specific detailed information is included for sites in Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming.

33372 (DOE/RA/11025—T1(Vol.4)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 206p. NTIS, PC A10/MF A01.

The estimates of existing, incremental and the undeveloped hydropower potential for all states in the various regions of the country are presented. In the Lake Central region, the maximum physical potential for all sites exceeds 26,000 MW with an estimated average annual energy of more than 75,000 GWH. By comparison, these values represent about 5% of both the total potential capacity and hydroelectric energy estimated for the entire US. Of the total capacity estimated for the region, 2600 MW has been installed. The remainder (23,600 MW) is the maximum which could be developed by upgrading and expanding existing projects (15,800 MW), and by installing new hydroelectric power capacity at all potentially feasible, undeveloped sites (7800 MW). Small-scale facilities account for some 24% of the region's total installed capacity, but another 900 MW could be added to these and other small water-resource projects. In addition, 900 MW could be installed at potentially feasible, undeveloped small-scale sites. The small-scale resource varies considerably, with the states of Michigan and Wisconsin having the largest potential for incremental development at existing projects in the Lake Central region. This Lake Central region is composed of Minnesota, Wisconsin, Michigan, Ohio, Indiana, Illinois, Kentucky, Missouri, and Iowa.

33373 (DOE/RA/11025—T1(Vol.5)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 184p. NTIS, PC A09/MF A01.

In the Southeast region, the maximum physical potential for all sites exceeds 48,000 MW with an estimated average annual energy of more than 137,000 GWH. By comparison, these values represent about 9% of both the total potential capacity and hydroelectric energy estimated for the entire US. Of the total capacity estimated for the region, 11,800 MW has been installed. The remainder (36,200 MW) is the maximum which could be developed by upgrading and expanding existing projects (13,000 MW), and by installing new hydroelectric power capacity at all potentially feasible, undeveloped sites (23,200 MW). Small-scale facilities account for some 2% of the region's total installed capacity, but another 700 MW could be added to these and other small water-resource projects. In addition, 1100 MW could be installed at potentially feasible, undeveloped small-scale sites. The small-scale resource varies considerably, with the states of North Carolina and South Carolina having the largest potential for incremental development at existing projects in the Southeast region. The Southeast region is composed of Arkansas, Louisiana, Mississippi, Tennessee, Alabama, Georgia, Florida, South Carolina, North Carolina, and Virginia.

33374 (DOE/RA/11025—T1(Vol.6)) **National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region.** (Institute for Water Resources (Army), Fort Belvoir, VA (USA); Hydrologic Engineering Center, Davis, CA (USA)). Jul 1979. Contract AI01-77RA11025. 292p. NTIS, PC A13/MF A01.

In the Northeast region, the physical potential for all sites exceeds 33,000 MW of capacity with an estimated average annual energy of some 153,000 GWH. By comparison, the available data represent about 6% of the total capacity and 11% of the hydroelectric energy potential estimated for the entire US. Of the total capacity estimated for the region, 6100 MW has been installed. The remainder (27,200 MW, excluding the undeveloped capacity in the New England States) is the maximum which could be developed by upgrading and expanding existing projects (18,700 MW), and by installing new hydroelectric power capacity at all potentially feasible, undeveloped sites (8500 MW). Small-scale facilities account for about 15% of the region's total installed capacity, but another 1800 MW could be added to these and other small water-resource projects. In addition, 500 MW could be installed at potentially feasible, undeveloped small-scale sites. The small-scale resource varies considerably, with the states of New York, Maine, and New Hampshire having the largest potential for incremental development at existing projects in the Northeast region. West Virginia, Maryland, Delaware, New Jersey, Pennsylvania, New York, Connecticut, Massachusetts, Rhode Island, New Hampshire, Vermont, and Maine comprise the Northeast region.

REGULATIONS AND LICENSING

33375 (DOE/RA/04934—05) **Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract AS02-

78RA04934. 147p. (CONF-791199—(Summ.)). NTIS, PC A07/MF A01.

From Conference on small-scale hydropower in the Midwest; Detroit, MI, USA (14 Nov 1979).

A variety of decision makers convened to examine and discuss certain significant problems associated with small-scale hydroelectric development in the Midwestern region, comprised of Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, and Wisconsin. The conference opened with an introductory panel of resource persons who outlined the objectives of the conference, presented information on small-scale hydro, and described the materials available to conference participants. A series of workshop sessions followed. Two of the workshop sessions discussed problems and policy responses raised by state and Federal regulation. The remaining two workshops dealt with economic issues confronting small-scale hydro development and the operation and usefulness of the systems dynamics model developed by the Thayer School of Engineering at Dartmouth College. A plenary session and recommendations completed the workshop.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33680

SOLAR ENERGY

REFER ALSO TO CITATION(S) 33712

33376 (DOE/CS—0155) **Department of Energy solar energy objectives, calendar year 1980.** (Department of Energy, Washington, DC (USA)). Apr 1980. 33p. NTIS, PC A15/MF A01.

This paper sets out the goals of the Department of Energy for calendar year 1980 with respect to the output of each of the solar energy programs authorized by Congress. The paper is organized functionally to describe the solar activities of the Department by the sector of the economy they are designed to serve. The first part sets out an overview of the Department's solar activities including the potential contribution by solar energy, the barriers to be overcome, and an aggregation of the output we expect in the calendar year 1980. The next six parts describe the Department's solar activities aimed at the six major solar-using sectors of the economy: residential, commercial, agricultural, industrial, transportation, and utilities. The eighth part summarizes the United States government's efforts to advance the international trade possibilities in solar energy. The ninth part describes the solar projects that affect more than three of the sectors described in the preceding seven parts. The appendix contains the name and telephone number of the Department of Energy official responsible for achieving each of the quarterly output objectives described in parts II through IX of the paper. The paper covers five categories of solar energy sources: (1) biomass, which includes all uses of renewable organic material either to burn directly or to convert to liquid or gas fuels; (2) solar thermal systems, including active and passive systems for collecting heat from sunlight to be used either for heating or cooling systems; (3) photovoltaic systems, which use cells of semi-conductor materials to convert sunlight directly to electricity; (4) wind-powered systems; and (5) ocean systems including ocean thermal energy conversion, salinity gradients, ocean currents, and wave energy.

33377 (SERI/SP—763-717) **Solar energy in Australia: a profile of renewable energy activity in its national context.** Case, G.L. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1980. Contract AC02-77CH00178. 83p. NTIS, PC A05/MF A01.

The following topics are included: country overview; energy summary; geopolitical, economic, and cultural aspects of Australia; the energy profile; and international agreements, contacts, manufacturers, and projects. (MHR)

33378 (TAC-STHC—79-004) **Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Apr 1980. 128p. Technology Application Center, Univ. of New Mexico, Albuquerque.

This annotated bibliography covers the following subjects: demonstrations, system overviews, computer models, thermal storage, architectural considerations, passive solar energy, thermal load computations, domestic water heating, solar radiation instruments and monitoring, swimming pools, and greenhouses. (MHR)

33379 (TAC-STPG—79-004) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Apr 1980. 146p. Technology Application Center, Univ. of New Mexico, Albuquerque.

This annotated bibliography contains the following subjects: energy overviews, solar overviews, energy conservation, economics and law, solar thermal power, thermionic and thermoelectric, ocean thermal energy conversion, biomass and photochemical energy, and large-scale photovoltaics. (MHR)

33380 (TAC-STPG—80-001) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jun 1980. 233p. Technology Application Center, Univ. of New Mexico, Albuquerque.

This annotated bibliography contains the following: energy overviews, solar overviews, energy conservation, economics and law, total energy systems, solar thermal power, thermionic and thermoelectric, ocean thermal energy conversion, wind power, biomass and photochemical energy, satellite power stations, and large-scale photovoltaics. (MHR)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 33389

33381 (DOE/ET/20174—1) **Coastal-inland solar radiation difference study. Final report.** Bach, W.D. Jr.; Vukovich, F.M. (Research Triangle Inst., Research Triangle Park, NC (USA)). Apr 1980. Contract AC02-77ET20174. 260p. NTIS, PC A12/MF A01.

The purpose of this study was to quantify the characteristics of solar insolation in the coastal zone and to determine the effect of the sea breeze circulation on the global insolation. In order to satisfy these objectives, a six station sampling network was established in the coastal plain of southeastern North Carolina, where previous evidence has indicated that the sea breeze circulation is almost a daily occurrence from late May through October. Three sites [Sloop Point, Onslow Beach, and Cape Fear Technical Institute (CFTI)] were located near the coast (coastal sites) to assess the insolation at the coast. A site (Clinton) was located in an area seldom affected by the sea breeze (about 100 km from the coast). Two additional sites, Wallace and Ellis Airport, located between the coastal sites and the control site, were to be used to assess the transient impact of the sea breeze upon the insolation. Pyranometers were located at each site to measure the global insolation. Direct normal insolation measured by a pyrheliometer and ultraviolet radiation measured by uv radiometers were observed at the Sloop Point and Clinton sites only. Data were collected during the calendar year 1978. The results of the study indicated that the global insolation had greater variability over the network during the summer season (June, July, and August). During the summer, there was a systematicdiurnal variation of the difference in global insolation between the inland and the coastal sites.

33382 **Inclination dependence of pyranometer sensitivity.** Reed, K.A. (Argonne National Lab., IL). Contract W-31-109-ENG-38. pp 106-108 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

The inclination dependence of the sensitivity of Eppley Model 8-48 pyranometers has been measured in indoor tests conducted at levels of illumination corresponding to roughly 500 and 1000 $w.m^{-2}$. The sensitivity is found to decrease as the pyranometer is tilted from the horizontal, the magnitude of the decrease depending on the level of the illumination as well as the angle of inclination. Outdoor comparisons of Eppley Model 8-48 and Model PSP pyranometers, although less well controlled, generally confirm the measured inclination dependence.

33383 **Experimental atmospheric extinction measurements at nine wavelengths between 0.3 and 10 μm.** Lerfald, G.; Derr, V. (National Oceanic and Atmospheric Administration, Boulder, CO). pp 109-113 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Accurate determinations of the widely varying spectral extinction of the direct solar beam by the earth's atmosphere has applications in several fields; these include solar energy, optical communication and remote sensing of atmospheric parameters. A system used to make extinction measurements at nine wavelengths in the 0.3 to 10 μm range is described and sample results are presented. Plans to use the data to study remotely the characteristics of clouds and aerosols, particularly the size distributions of the particles along the transmission path, are discussed.

33384 (DOE/ET/20090—4) **Solar index prediction methodology preliminary analysis.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). [nd]. Contract AC02-78ET20090. 6p. NTIS, PC A02/MF A01.

Several methodologies which could be utilized to minimize the error in predicting percent sun, average ambient temperature and the Solar Index are described. (MHR)

ECONOMICS

REFER ALSO TO CITATION(S) 33510

33385 (NP—24996) **Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies.** Johnson, D. (California Energy Commission, Sacramento (USA)). Sep 1979. 120p. TIC.

The purpose of program SOLFIN (solar financial incentives) is to evaluate the economics of various solar technologies and rank the incentive programs in terms of their relative impacts on the consumers expected economics evaluation of the solar technology.

33386 (P—104-80-002) **User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings.** Johnson, D.; Tibbs, D.; Woo, C.K. (California Energy Commission, Sacramento (USA)). May 1980. 177p. California Energy Commission, Sacramento.

The California Energy Commission's SOLFIN2 computer code was developed to provide end-use economic analysis. The methodological procedure is predicated on the comparison of two structures: base and alternative. Energy systems and system components are described for each structure as are natural gas and electricity loads and prices, financing terms, tax parameters, inflation and discount rates. Based on these inputs, SOLFIN2 presents the following analytical results: (1) annual cash flow projections for both structures of the following operating and ownership cost accounting items: fuel costs (natural gas and electricity), maintenance costs, replacement costs, miscellaneous operating costs, insurance costs, property tax, interest cost, debt payment, income tax credits, gross income tax savings, federal-state income tax interaction, and depreciation, and (2) investment criteria as measures of the comparative economic viability of the two structures. These include: payback period (discounted and undiscounted); benefit cost ratio and present value; life-cycle cost, levelized cost and levelized cost per million Btu of end-use energy; and ratio of life-cycle costs. The payback periods, benefit-cost ratio and present value are based upon comparisons of the incremental gains and costs arising from an investment in the energy systems described for the alternative structure in place of those in the base structure. On the other hand, life-cycle cost, levelized cost and levelized cost per million Btus of energy used are totals estimated for both structures. The ratio of the life-cycle cost of owning and operating the energy systems in the base structure to the corresponding life-cycle cost for the alternative structure is an investment criterion based on these totals. SOFLIN2 can be used to establish cost comparisons from the perspective of the consumer.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 33396, 33398, 33400, 33401, 33680, 34109, 34111, 34115, 34116, 34196, 34197, 34203, 34205, 34206, 34207, 34208, 34209, 34210, 34211, 34212, 34213, 34214, 34215, 34216, 34217

33387 (BNL—51118) **Health effects of photovoltaic technology.** Stang, L.; Dienes, M.; Bohning, D. (eds.). (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 333p. (CONF-790752—). NTIS, PC A15/MF A01.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The 34 papers presented were entered in the data base separately. (WHK)

33388 (P—500-79-016) **Regulations for the California Solar Energy Tax Credit.** (California Energy Commission, Sacramento (USA)). Jul 1979. 18p. California Energy Commission, Sacramento.

Guidelines which specify solar energy system and energy conservation measures applied in conjunction with solar energy systems which are eligible for California state tax credits are presented. (WHK)

33389 (P—500-80-013) **Protecting solar access: a guidebook for California communities.** Jaffe, M. (American Planning Association, Chicago, IL). Mar 1980. 173p. California Energy Commission, Sacramento, CA.

The following topics are included: the basics of solar access, planning for solar access, zoning for solar access, subdivision regulations and solar access, regulating trees and landscaping for solar access, solar access in environmental impact reports and site plan reviews, and solar access covenants and easements. (MHR)

33390 (SERI/RR—722-329R) **Social values and solar energy policy: the policy maker and the advocate.** Shama, A.; Jacobs, K. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-76CH00178. 70p. NTIS, PC A04/MF A01.

Solar energy policy makers and advocates have significantly different hierarchies (clusters) of values upon which they evaluate the adoption of solar technologies. Content analysis, which examines the frequency with which policy makers identify different types of values, indicates that they hold economic values to be of primary importance. Environmental, social, and national security values are also substantial elements of the policy makers' value clusters associated with solar energy. This finding is confirmed by a qualitative analysis of policy makers' values. Advocates, on the other hand, assign almost equal weights (33%) to economic values and social values, slightly less weight to environmental values, and significant attention to ethical and security values as well. These results of frequency analysis are made somewhat more complicated by a qualitative interpretation of the advocates' positions. As part of their more holistic approach, several of the advocates indicated that all values discussed by them are instrumental toward achieving higher-order, ethical and environmental values. In addition, our preliminary investigation indicates that neither group is entirely homogeneous. Testing this and other propositions, as well as obtaining a similar picture of the values which the public associates with solar energy, are topics of future research.

33391 (SERI/SP—98156-1) **Solar envelope zoning: application to the city planning process. Los Angeles case study.** (Los Angeles Mayor's Office, CA (USA); Los Angeles Dept. of City Planning, CA (USA); Los Angeles City Attorney's Office, CA (USA)). Jun 1980. Contract AC02-77CH00178. 192p. NTIS, PC A09/MF A01.

Solar envelope zoning represents a promising approach to solar access protection. A solar envelope defines the volume within which a building will not shade adjacent lots or buildings. Other solar access protection techniques, such as privately negotiated easements, continue to be tested and implemented but none offer the degree of comprehensiveness evident in this approach. Here, the City of Los Angeles, through the Mayor's Energy Office, the City Planning Department, and the City Attorney's Office, examine the feasibility of translating the concept of solar envelopes into zoning techniques. They concluded that envelope zoning is a fair and consistent method of guaranteeing solar access, but problems of complexity and uncertainty may limit its usefulness. Envelope zoning may be inappropriate for the development of high density centers and for more restrictive community plans. Aids or tools to administer envelope zoning need to be developed. Finally, some combination of approaches, including publicly recorded easements, subdivision approval and envelope zoning, need to be adopted to encourage solar use in cities. (MHR)

33392 (SERI/TR—733-394) **Summary of the DPR.** Easterling, J.; Grace, A.; Kettle, R. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-76CH00178. 46p. NTIS, PC A03/MF A01.

This report summarizes the Domestic Policy review (DPR) recommendations and the resulting Administration-adopted recommendations in table form. In addition, barriers identified and assumptions used by the panels are listed. A brief history of the Domestic Policy Review and a definition of categories is included.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 33387, 33442, 33521

33393 (BNL—51118, pp 10-29) **Overview of the national photovoltaic program.** Magid, L.M. (Department of Energy, Washington, DC). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

A general description of photovoltaics and solar cells and how they work is given. Some background on the current work being done by the industry is presented, and the national photovoltaic program plans now being deveioped and goals for the next 15 or 20 years are discussed. (WHK)

33394 (BNL—51118, pp 44-50) **Cadmium sulfide.** Meakin, J.D. (Univ. of Delaware, Wilmington). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The state-of-the-art of cadmium sulfide solar cells is reviewed. Cadmium sulfide solar cell fabrication, efficiency, commercialization, cost, and health aspects are discussed. (WHK)

33395 (BNL—51118, pp 62-72) **Advanced research and development on photovoltaic materials.** Burke, J.R. (Solar Energy Research Inst., Golden, CO). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Research on identification of new photovoltaic concepts and materials is reviewed. Semiconductor materials, electric contact materials, antireflection coatings, substrates, feedstocks, dopants, and processing materials are considered; and new fabrication processes are discussed. (WHK)

33396 (BNL—51118, pp 76-78) **Environmental controls at Motorola.** Hild, N.R. (Motorola Corp., Phoenix, AZ). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Safety and environmental aspects of solar cell manufacturing are discussed from the viewpoint of the Motorola Corporation, based on years of experience in the semiconductor device manufacturing business. (WHK)

33397 (BNL—51118, pp 82-86) **Silicon processes.** McCormick, J. (Hemlock Semiconductor Corp., MI). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Chemical processes for the production and purification of silicon are discussed, and the projected market for silicon is plotted. (WHK)

33398 (BNL—51118, pp 87-90) **Photon Power's sprayed cadmium sulfide/cuprous sulfide photovoltaic solar cells.** Locke, P. (Photon Power, Inc., El Paso, TX). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Processes and environmental and in-plant pollution at Photon Powers's pilot plant for manufacturing cadmium sulfide/cuprous sulfide solar cells are briefly discussed. (WHK)

33399 (BNL—51118, pp 91-93) **Photovoltaic programs at RCA.** Robinson, P. (RCA Lab., Princeton, NJ). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

At present RCA does not have a commercial photovoltaic product, but it hopes to in the future. At the Research Center, the major emphasis in R & D is on getting cost-effective processes and improving solar cell performance. The three major programs are on amorphous silicon solar cells, flat-panel silicon automated array assemblies, and an epitaxial technique for silicon solar cell fabrication. These programs are described. (WHK)

33400 (BNL—51118, pp 104-106) **Cadmium sulfide cells.** Freedman, N.S. (SES, Inc. Newark, DE). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

A brief description of the facility and process at SES, Inc. for producing cadmium sulfide solar cells is given; occupational safety is considered. (WHK)

33401 (BNL—51118, pp 109-110) **Industrial hygiene of photovoltaic cell production.** Briggs, T. (PEDCo Environmental, Inc., Cincinnati, OH). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

An industrial hygiene study of the photovoltaics industry is briefly described. Fourteen solar cell production facilities were visited. The study was restricted to in-plant exposures and industrial hygiene, excluding environmental effects. (WHK)

33402 (DOE/ET/20279—101) **Portable, X-Y translating, infrared microscope for remote inspection of photovoltaic solar arrays.** Forman, S.E.; Caunt, J.W. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET20279. 5p. (CONF-801041—1). NTIS, PC A02/MF A01.

From International symposium for testing and failure analysis; Los Angeles, CA, USA (27 Oct 1980).

The prevalent physical defect found in terrestrial photovoltaic modules during manufacture and field exposure has been the cracked solar cell. Cells can become cracked during handling, because of thermal mismatch in their encapsulation packages, or due to environmental phenomena such as hail. A device is described which can be used remotely to locate cracked silicon solar cells in photovoltaic modules. This solar-cell inspection device can be used either in the laboratory for quality assurance and failure analysis evaluation or at array fields to monitor cracked-cell occurrence. It consists of: (a) an infrared microscope that operates at 1.0 micron, uses darkfield illumination, has a relatively large field of view (3.0 in.), has low system magnification (5X to 15X), and has a video display output; (b) a portable X-Y translator that is capable of moving the microscope over an 8 ft. x 8 ft. area; and (c) a console that allows remote instrument control and visual inspection of modules or arrays (up to 500 ft). This system presently is undergoing laboratory and field testing as part of the DOE-sponsored MIT Lincoln Laboratory Solar Photovoltiac Residential Project.

33403 (DOE/JPL/954873—8) **Phase 2 of the array automated assembly task for the Low Cost Solar Array Project. Final report, October 1, 1978-October 30, 1979.** Campbell, R.B.; Davis, J.R.; Ostroski, J.W.; Rai-Choudhury, P.; Rohatgi, A.; Seman, E.J.; Stapleton, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1979. Contract NAS-7-100-954873. 150p. NTIS, PC A07/MF A01.

The process sequence for the fabrication of dendritic web silicon into solar panels has been modified to include aluminum back surface field formation. Sputtering is the preferred method for depositing the aluminum. Plasma etching has been shown to be a feasible technique for pre-diffusion cleaning of the web. This would replace wet chemical cleaning. Several contacting systems have been studied. The total plated Pd-Ni system (Motorola Process) is not compatible with our process sequence; however, the evaporated TiPd-electroplated Cu system has been shown stable under life testing. Ultrasonic bonding parameters have been determined for various interconnect and contact metals but the yield of the process is not sufficiently high to use for module fabrication at this time. Over 400 solar cells, about 11 cm^2 in area have been fabricated according to the modified sequence. No sub-process incompatibility was seen. These cells have been used to fabricate four demonstration modules. A cost analysis (SAMICS) of the modified process sequence resulted in a selling price of $0.75/peak watt (1980$ in 1986).

33404 (IS—4723) **Efficient solar cells by space processing. Final report, October 1, 1978-December 14, 1979.** Schmidt, F.A.; Campisi, G.J.; Bevolo, A.J.; Shanks, H.R.; Williams, D.E. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 78p. NTIS, PC A05/MF A01.

Thin films of electron beam evaporated silicon were deposited on molybdenum, tantalum, tungsten and molybdenum disilicide under ultrahigh vacuum conditions. Mass spectra from a quadrapole residual gas analyzer were used to determine the partial pressure of 13 residual gases during each processing step. Surface contamination and interdiffusion were monitored by in-situ Auger electron spectrometry. The substrates were characterized by x-ray analysis and SEM in the topographical and electron diffraction mode. It was found that on polycrystalline tungsten with a (100) orientation, silicon was grown with a grain size measuring 3000 A in cross section and with (110) orientation below 630°C. At 670°C, silicon grains had grown to one micron in cross section and these grains had (111) and (110) orientations. On polycrystalline molybdenum substrates with (100) orientation, silicon grains measuring 2000 A across grew with a (110) orientation as high as 670°C. The presence of phosphorus in the silicon was responsible for attaining these elevated temperatures with silicide formations. Heteroepitaxial silicon was grown on polycrystalline $MoSi_2$ at 800°C. The silicon grew on (111) $MoSi_2$ grains. This growth was sensitive to the presence of oxygen during deposition, the rate and length of deposition as well as the substrate orientation. Above 950°C silicon growth was no longer heteroepitaxial but crystals 80 μm in cross section were obtained. The presence of oxygen at a partial pressure of 1×10^{-10} torr was found to reduce the size of silicon grains at 1100°C.

33405 (PNL-SA—7778) **Metal-insulator-semiconductor photovoltaic devices.** Olsen, L.C.; Garnier, J.E.; Turcotte, R.P. (Joint Center for Graduate Study, Richland, WA (USA)). Jun 1979. Contract AC06-76RL01830. 27p. (CONF-7906185—1). NTIS, PC A03/MF A01.

From Polycrystalline silicon solar cells DOE/SERI contractors meeting; Arlington, VA, USA (14 Jun 1979).

The overall objective of this program is to conduct research on metal-insulator-semiconductor (MIS) solar cells to improve understanding of the basic parameters which control photovoltaic processes in these cell structures. Current work includes fabrication, characterization, and theoretical studies of single crystal silicon-based cells, with Si0/sub x/ as the insulating film and Al or Au as the front metal contact. Studies of these two systems are intended to provide needed reference systems from which improved single crystal or polycrystalline devices can be systematically developed. The approach to cell fabrication involves growth of a Si0/sub x/ layer on a silicon substrate, and subsequent evaporation of a metal layer for the front contact by vacuum evaporation or electron beam deposition. Characterization of cells involves both physical and electro-optical measurements. Scanning Auger electron spectroscopy (AES) and secondary ion mass spectroscopy (SIMS) are utilized to determine depth concentration profiles and the nature of bonding in the interfacial region. Electron-optical measurements include current-voltage, capacitance-voltage, and spectral photoresponse measurements with the completed cell. In addition, ellipsometric measurements are utilized to determine oxide film thickness and the optical

parameters for metal films on silicon. These results are compared to parameters determined from reflection and transmission measurements made on films deposited on quartz. Progress is reported.

33406 (SERI/PR—0-8274-3) **Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 3, 25 March-24 June 1980.** D'Aiello, R.V.; Robinson, P.H. (RCA Labs., Princeton, NJ (USA)). Jul 1980. Contract AC02-77CH00178. 34p. NTIS, PC A03/MF A01.

During the third quarter, the practical aspects of making epitaxial solar cells were emphasized by exploring the growth and fabrication of large-area cells. In this work, a significant achievement was the attainment of efficiencies close to 10% with epitaxial cells of 10.8 cm^2 area grown on the lowest grade silicon substrate under study. For larger areas (23.1 cm^2) an efficiency of 7.0% was obtained in the first experiment. The use of low-cost surface preparation techniques was successfully demonstrated for both epitaxial growth and the resultant solar-cell properties. Some requirements on the subsequent application of AR coatings are pointed out. Work on the use of silane as an alternate gaseous silicon source was extended by exploring growth on UMG silicon substrates. The results continue to show equivalent performance for cell structures grown in silane at 1000°C with those grown using dichlorosilane at 1100 to 1150°C.

33407 (SERI/PR—0-8276-3) **Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980.** Funghnan, B.W.; Blanc, J.; Phillips, W.; Redfield, D. (RCA Labs., Princeton, NJ (USA)). Aug 1980. Contract AC02-77CH00178. 54p. NTIS, PC A04/MF A01.

Thirty-four new solar cells were fabricated on Wacker Silso substrates and the AM-1 parameters were measured. A detailed comparison was made between the measurement of minority carrier diffusion length by the QE method and the penetrating-light laser-scan grain-boundary photoresponse linewidth method. The laser scan method has more experimental uncertainty and agrees within 10 to 50% with the QE method. It allows determination of L over a large area. Atomic hydrogen-passivation studies continued on Wacker material by three techniques. A method of determining surface recombination velocity, s, from laser scan data was developed. No change in s in completed solar cells after H-plasma treatment was observed within experimental error. H-passivation of bare silicon bars as measured by the new laser scan - photoconductivity technique showed very large effects. This method measures majority carrier effects which are sensitive to changes in GB barrier heights. Finally, H-passivation was studied in silicon-ITO heterojunction structures so that a phosphorus diffusion step was not necessary to observe minority carrier effects. Preliminary results showed a 50% reduction in s from 1.8×10^5 cm/s to 1.2×10^5 cm/s. However, both values are higher than what is observed in phosphorus-diffused cells, i.e., $s = 7 \times 10^3$ cm/s. Laser scans and QE measurements were carried out on three low-cost substrates: Crystal Systems cast silicon, Mobil-Tyco ribbon, and RCA epitaxial layer on Dow metallurgical grade substrate. Etching studies were initiated to observe dislocations and stacking faults in polycrystalline silicon.

33408 (SERI/PR—611-737) **Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980.** Zunger, A. (ed.). (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 104p. NTIS, PC A06/MF A01.

This report covers the research activities in SERI's Photovoltaic Research Branch during the period 1 October 1979 to 31 March 1980. It includes separate reports on: solid-state theory, high-efficiency cells, thin-film cells, silicon purification, silicon crystallization, thick-film technology, surface and interface analysis, and growth of GaAs and related compounds by metal-organic chemical vapor desposition.

33409 (SERI/PR—8119-2-T1) **Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. First quarterly progress report, October 1-December 31, 1979.** Gass, W.R.; Kanter, I.E.; Witkowski, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 14 Mar 1980. Contract AC02-77CH00178. 29p. NTIS, PC A03/MF A01.

The goals of this program are to identify and develop economical processes for fabricating large grain size polycrystalline silicon substrates by electrodeposition techniques suitable for photovoltaic applications. Studies have begun to evaluate the technical feasibility for producing thin-film polycrystalline silicon sheet by molten salt electrolytic plating techniques. Purified metallurgical grade silicon and silica will be investigated as inexpensive feedstocks for the electrodeposition process.

33410 (SERI/PR—8119-2-T2) **Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. Second quarterly progress report, January 1-March 31, 1980.** Gass, W.R.; Kanter, I.E.; Witkowski, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 5 Jun 1980. Contract AC02-77CH00178. 43p. NTIS, PC A03/MF A01.

The goals of this program are to identify and develop economical processes for fabricating large grain size polycrystalline silicon substrates suitable for photovoltaic applications. Studies have begun to evaluate the technical feasibility for producing thin-film polycrystalline silicon sheet by molten salt electrolytic plating techniques. Purified metallurgical grade silicon and silica will be investigated as inexpensive feedstocks for the electrodeposition process. Acid leaching has been shown to reduce the concentration of major photovoltaic performance affecting impurities by a factor of 10 or more. Large (10 to 50 μm) silicon crystals have been successfully electroplated onto 1 cm x 1 cm substrate sheets.

33411 (SERI/PR—8278-1-T3) **Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly report, 1 April-30 June 1980.** Feldman, C.; Arrington, C.H. III; Blum, N.A.; Satkiewicz, F.G. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Aug 1980. Contract AC0277CH00178. 50p. NTIS, PC A03/MF A01.

Polycrystalline p-type films were vacuum deposited onto TiB_2 coated alumina and sapphire substrates. Epitaxial layers were also formed on single crystal silicon substrates. Junctions in the layers were created by both gaseous diffusion in a tube furnace and by vacuum deposition. The TiB_2 vacuum deposited bottom electrodes have resistivities between 30 and 40 μ Ω-cm. All-vacuum-deposited solar cells were fabricated for the first time. Efficiencies approaching those in the diffused junction devices were achieved. The n-layers were deposited on the previously deposited p-layer/TiB_2/ceramic sandwiches by vacuum deposition of silicon in a phosphine (PH_3) atmosphere. Photovoltaic data in diffused junction samples, including efficiency and spectral response measurements, indicate that crystallite size may no longer be the limiting factor in achieving high efficiency; rather, performance is now being limited by the presence of impurities in the vacuum deposition silicon base region.

33412 (SERI/PR—9192-1-T1) **Thin film polycrystalline silicon solar cells: first technical progress report, April 15, 1980-July 15, 1980.** (Poly Solar, Inc., Garland, TX (USA)). Jul 1980. Contract AC02-77CH00178. 30p. NTIS, PC A03/MF A01.

The objectives of this contract are to fabricate large area thin film silicon solar cells with AM1 efficiency of 10% or greater with good reproducibility and good yield and to assess the feasibility of implementing this process for manufacturing solar cells at a cost of $300/kWe. Efforts during the past quarter have been directed to the purification of metallurgical silicon, the preparation of substrates, and the fabrication and characterization of solar cells. The partial purification of metallurgical silicon by extraction with aqua regia has been investigated in detail, and the resulting silicon was analyzed by the atomic absorption technique. The unidirectional solidification of aqua regia-extracted metallurgical silicon on graphite was used for the preparation of substrates, and the impurity distribution in the substrate was also determined. Large area (> 30 cm^2) solar cells have been prepared from aqua regia-extracted metallurgical silicon substrates by the thermal reduction of trichlorosilane containing appropriate dopants. Chemically deposited tin-dioxide films were used as antireflection coatings. Solar cells with AM1 efficiencies of about 8.5% have been obtained. Their spectral response, minority carrier diffusion length, and I/sub sc/-V/sub oc/ relation have been measured.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 33359, 33362, 33363, 33365, 33366, 33368, 33840, 33841, 33842, 33843, 34116, 34143

33413 **Hydrocarbon production from arid land plant species.** Hinman, C.W.; Hoffmann, J.F.; McLaughlin, S.P.; Peoples, T.R. Phoenix, AZ; American Section of the International Solar Energy Society, Inc. (1980). 5p. Diamond Shamrock Corp., Tucson, AZ.

Suggestions that certain plant species could serve as alternative sources of liquid hydrocarbons have led to an indepth evaluation of their potential. Investigations of Euphorbia lathyris in terms of its chemical composition, hydrocarbon yield, biomass yield and cultivation parameters are described in this presentation.

33414 (BNL—50982) **Crop residues as a fuel for power generation.** Bhagat, N.; Davitian, H.; Pouder, R. (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract AC02-76CH00016. 20p. NTIS, PC A02/MF A01.

Crop residues could serve as an alternative energy source for producing electric power and heat in agricultural regions of the United States. Nearly 2 quads of residues are estimated to be available as a sustainable annual yield. These can substitute for up to one quad of conventional fuels used to generate electricity and up to an additional quad of petroleum and natural gas currently used for producing heat. The most promising routes to residue conversion appear to be regional generators sized in the megawatt range, and the mixing of residues with coal for burning in coal power plants.

Costing farmers from $0.70 to $1.25 per million Btu, to harvest and prepare for use as a fuel, residues can be a competitive renewable energy supply.

33415 (CONF-790520—) **Third international symposium on alcohol fuels technology.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Apr 1980. Contract FG03-79CS50015. 714p. NTIS, PC A99/MF A01.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

At the opening of the Symposium, Dr. Sharrah, Senior Vice President of Continental Oil Company, addressed the attendees, and his remarks are included in this volume. The Symposium was concluded by workshops which addressed specific topics. The topical titles are as follows: alcohol uses; production; environment and safety; and socio-economic. The workshops reflected a growing confidence among the attendees that the alcohols from coal, remote natural gas and biomass do offer alternatives to petroleum fuels. Further, they may, in the long run, prove to be equal or superior to the petroleum fuels when the aspects of performance, environment, health and safety are combined with the renewable aspect of the biomass derived alcohols. Although considerable activity in the production and use of alcohols is now appearing in many parts of the world, the absence of strong, broad scale assessment and support for these fuels by the United States Federal Government was a noted point of concern by the attendees. The environmental consequence of using alcohols continues to be more benign in general than the petroleum based fuels. The exception is the family of aldehydes. Although the aldehydes are easily suppressed by catalysts, it is important to understand their production in the combustion process. Progress is being made in this regard. Of course, the goal is to burn the alcohols so cleanly that catalytic equipment can be eliminated. Separate abstracts are prepared for the Energy Data Base for individual presentations.

33416 (CONF-790520—, pp II.39.1-II.39.11) **Technical and economic assessment motor fuel alcohol from grain and other biomass.** Moon, G.D. Jr.; Messick, J.R.; Easley, C.E.; Katzen, R. (Raphael Katzen Associates, Cincinnati, OH). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

The primary objective of this study was to evaluate the technical and economical feasibility for production of grain motor fuel ethyl alcohol from a grass roots plant with a capacity of 50 million US gal/yr. The base case evaluation includes a detailed process design using proven technology, a complete budget estimate of the plant investment including working capital, a detailed analysis of the annual operating cost using corn as the primary feedstock, and a complete financial analysis which establishes the alcohol selling price required to net to the investor a 15% discounted cash flow - interest rate of return. In addition to the primary objective, other considerations discussed in the paper are: excursions on plant capacities, excursions on feedstock material, sensitivity analyses on financial parameters, and substitution of corn stover for coal as the primary fuel source.

33417 (CONF-790520—, pp II.44.1-II.44.10) **Legal and regulatory influences on alcohol fuels use in the United States.** Ecklund, E.E. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

During the last year, grass-roots in Gasohol has resulted in commercial sales going from zero to 6 million US gallons (600,000 gallons ethanol) in January 1979. This started in the Midwest United States on the basis of motorist appeal without benefit of incentives, spread with the benefit in some cases of State incentives and was further encouraged by the waiver of 4 cents-per-gallon Federal excise tax for fuels with 10-volume percent alcohol from renewable resources. Continuation depended on a favorable ruling under the Clean Air Act by the Environmental Protection Agency, which also acted favorably on use of tertiary butyl alcohol and methyl tertiary butyl ether as octane improvers. Other supportive Federal actions include loan guarantee for a processing plant to convert bagasse to ethanol, planned initiation of reliability fleet tests on advanced alcohol/gasoline blend compositions, and establishment of a Congressional National Alcohol Fuels Commission to determine what can and should be done to help alcohol fuels find their appropriate levels in replacing petroleum.

33418 (CONF-800814—7) **Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes).** Klass, D.L.; Ghosh, S. (Institute of Gas Technology, Chicago, IL (USA)). 1980. 17p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Water hyacinth under conventional high-rate digestion conditions exhibited higher methane yields and energy recovery efficiencies when grown in sewage-fed lagoons as compared to the corresponding values obtained with water hyacinth grown in a freshwater pond. Mesophilic digestion provided the highest feed energy recovered in the product gas as methane while thermophilic digestion, when operated at sufficiently high loading rates and reduced detention times, gave the highest specific methane production rates. Methane yields, volatile solids reduction, and energy recovery as methane for the sewage-grown water hyacinth were in the same range as those observed for other biomass substrates when digested under similar conditions.

33419 (CONF-7911103—1) **Sugar-based fermentation for fuel alcohol.** Irvine, J.E. (Department of Agriculture, Houma, LA (USA). Sugarcane Field Lab.). 1979. 12p. TIC.

From 1. InterAmerican conference on renewable sources of energy; New Orleans, LA, USA (25 Nov 1979).

Sugarcane, sweet sorghum, and sugar beets are discussed as feedstocks for fuel alcohol fermentation. Land availability and processing costs are reviewed. (MHR)

33420 (CONF-8006100—1) **Uses of tree legumes in semi-arid regions.** Felker, P. (California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences). 1980. Contract FG01-78ET20023. 29p. NTIS, PC A03/MF A01.

From Symposia on legumes; Bloomington, IN, USA (Jun 1980).

Uses of tree legumes in semi-arid and arid regions are reviewed. This review is divided into sections according to the following general use categories: fuels; human food; livestock food; to increase yields of crops grown beneath their canopies;and control of desertification. (MHR)

33421 (DOE/CH/00178—T5) **Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979.** Ryther, J.H. (Woods Hole Oceanographic Institution, MA (USA)). Jan 1980. Contract AC02-77CH00178. 17p. NTIS, PC A02/MF A01.

Progress for the period May 1979 to December 1979 is reported in the following subject areas: (1) the ORCA clone of the red seaweed Gracilaria tikvakiae has now been grown continuously in tank culture for two years; (2) studies were continued on the culture of freshwater plants such as water hyacinth, pennywort, water lettuce, and duckweed; (3) the loss of water from evapotranspiration of freshwater plants was measured and compared with water loss from evaporation from open water; and (4) experiments were conducted to investigate the possibility of recycling the chemicals left in the solid and liquid residues following anaerobic digestion and methane production as a source of nutrients for new plant production. (ACR)

33422 (DOE/ET/20049—T1) **Fuels from woody biomass. First annual report, 3 April 1978-2 January 1979.** (Kansas State Univ., Manhattan (USA). Dept. of Forestry). 1979. Contract FG01-78ET20049. 16p. NTIS, PC A02/MF A01.

This project is being conducted to provide baseline data on biomass production, field management techniques and economic/energy costs of the energy forest in central and western Kansas. During 1978 three sites in central Kansas were planted to fast growing hardwood tree seedlings having the capability of sprouting when cut. In 1979, three additional sites in central and western Kansas will be planted to test additional site/climatic conditions. Black locust, catalpa and cottonwood were planted in 1/5 acre circular plots with 30 spokes at seven planting densities, ranging from 3 1/2 to 11 feet apart. The program is on schedule with three of six sites planted. Even under trying growing conditions this summer, survival is roughly 80%. (MHR)

33423 (DOE/ET/20593—T1) **Fuels from Woody Biomass Program. Quarterly report, February 1 to June 1, 1980.** (Seattle City Light, WA (USA). Dept. of Lighting Conservation). 1980. Contract FG01-78ET20593. 10p. NTIS, PC A02/MF A01.

The planting of 7500 alder wildlings and 7500 cottonwood cuttings on one site and irrigation problems at another are described. Progress in management tasks is mentioned. (MHR)

33424 (DOE/TIC—11247) **Fuels from biomass systems for arid land environments.** Lipinsky, E.S.; Kresovich, S. (Battelle Columbus Labs., OH (USA)). 1979. Contract W-7405-ENG-92-102. 13p. NTIS, PC A02/MF A01.

From Proceedings of the international arid lands conference on plant resources, Texas Tech University.

Integrated fuels from biomass systems that might function in arid environments are discussed and illustrated. The emphasis is on principles and strategic guidelines for use by those initiating studies on arid land fuels from biomass. (MHR)

33425 (NP—25010) **Janata biogas plant.** Bahadur, S.; Singh, K.K. (State Planning Inst., U. P., Lucknow (India). Planning Research and Action Div.). Mar 1980. 42p. NTIS (US Sales Only), PC A03/MF A01.

Portions of document are illegible.

The Janata biogas plant is based on the use of local materials and locally available skills only. It is a proven technology at low cost and easy maintenance which should facilitate its extension at a much faster pace especially among the low income groups. This technology is important at this time because of the current crisis in the availability of firewood and mineral fuels. This handbook explains in non-technical language the basic features, design, and construction of this biogas plant. (DC)

33426 (NP—25011) **Energy substitution in rural domestic sector: use of cattle dung as a source of fuel.** Mahdi, S.S.; Misra, R.V. (Tata Energy Research Inst., Bombay (India)). 1979. 17p. NTIS (US Sales Only), PC A02/MF A01.

Portions of document are illegible.

Channeling of cattle dung through a biogas production system has tremendous potential to meet the fuel energy and fertilizer needs of the rural people. Fuel energy generation and fertilizer potentials of cattle dung are discussed. Research and development efforts and problems in the implementation of biogas are also discussed. (DC)

33427 (NP—25045) **Anaerobic digestion of kelp.** Chynoweth, D.P.; Ghosh, S.; Klass, D.L. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. 47p. NTIS, PC A03/MF A01.

A stable fermentation was obtained for the mesophilic biomethanation of giant brown sea kelp under conventional conditions in bench-scale fermentors. The methane yield of 0.28 m^3/kg VS added obtained regularly for this feed substrate is high as compared with values reported for other wastes and biomass types composed primarily of carbohydrates, including municipal solid wastes, grass, feedlot cattle waste, and dairy manure. The anaerobic fermentation of raw kelp is not limited by phosphorus, or nitrogen when the C/N ratio is 17 or less. Thermophilic digestion of kelp resulted in an unstable fermentation and lower methane yields as compared with the mesophilic fermentation. Addition of kelp without dilution water or diluted with seawater resulted in retarded digestion. Two inocula derived from anaerobic marine environments did not show improved performance over IGT's inoculum developed from digesters receiving sewage sludge and municipal solid wastes. Most of the methane is derived from decomposition of algin and mannitol, and protein and cellulose represent the major refractory components of the effluent solids. It has not been determined whether the effluent solids protein is associated with kelp or bacteria produced by fermentation. Preliminary studies showed that heat alone and acid and alkaline hydrolysis in the presence of heat increased the biodegradability of the effluent solids. Studies in progress on the biomethanation of kelp are aimed at decreasing the reactor size through optimization of the retention time and loading and increasing the methane yield through evaluation of various post-treatment processes, culture optimization, and phase separation.

33428 **Biological applications of solar energy.** Gnanam, A.; Krishnaswamy, S.; Kahn, J.S. (eds.). Madras, India; Madurai Kamaraj University (1980). 232p. (CONF-781273—).

From International symposium on biological applications of soalr energy; Madurai, India (1 Dec 1978).

Articles presented and discussed during the symposium held at Madurai Kamaraj University in December 1978 are included. The theme of the symposium was to look into the solar option as an alternate source of energy to the traditional commercial forms through photosynthetic means for biomass and biofuel production. The articles are grouped into eight parts: global and regional aspects of solar energy; photosynthesis and productivity; field; nitrogen fixation; biomass; extreme environment; model systems; and biofuels and chemicals. (DC)

33429 (OTA-E—124) **Energy from biological processes.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1980. 206p. GPO.

This assessment responds to a request by the Senate Committee on Commerce, Science, and Transportation for an evaluation of the energy potential of various sources of plant and animal matter (biomass). This report complements an earlier OTA report on the Application of Solar Technology to Today's Energy Needs in evaluating the major solar energy resources available to the United States. The findings also will serve as part of the material to be used in an upcoming OTA assessment of synthetic fuels for transportation. This volume presents analyses of prominent biomass issues, summaries of four biomass fuel cycles, a description of biomass' place in two plausible energy futures, and discussions of policy options for promoting energy from biomass. The four fuel cycles - wood, alcohol fuels, grasses and crop residues, and animal wastes - were chosen because of their near- to mid-term energy potential and because of the public interest in them. A second volume presents technical analyses of the resource base, conversion technologies, and end uses that provide a basis for the discussion in this volume. Also included in Volume II are various unconventional approaches to bioenergy production as well as the use of biomass to produce chemicals.

33430 (OTA-TM-E—1) **Gasohol.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1979. 89p. GPO.

The Office of Technology Assessment is currently preparing an assessment of energy from biological processes. In the course of this study we have carried out an extensive analysis of alcohol fuels from agricultural products. This technical memorandum presents these findings in response to congressional interest in synthetic fuels. The purpose of the memorandum is to illuminate the technical and non-technical issues surrounding the development of gasohol. It discusses the resource base, production technologies, and economics of gasohol, and its use as a transportation fuel. The report also contains a discussion of the environmental problems and benefits of producing and using gasohol, and the social and institutional issues about using agricultural products for energy. While the memorandum does not present an analysis of policy issues, it does provide estimates of how much gasohol can be used at what cost, and the long-term prospects for ethanol production. All are important to the current congressional debate over development of a gasohol policy. The final report on energy from biological processes is scheduled for delivery to Congress in January 1980 and will contain an analysis of policy options about gasohol as well as other bioenergy technologies such as wood and methanol production.

33431 (SERI/TR—8157-1-T1) **Feasibility study for anaerobic digestion of agricultural crop residues. Dynatech report No. 1935.** Ashare, E.; Buivid, M.G.; Wilson, E.H. (Dynatech R/D Co., Cambridge, MA (USA)). 31 Jul 1979. Contract AC02-77CH00178. 251p. NTIS, PC A12/MF A01.

The objective of this study was to provide cost estimates for the pretreatment/digestion of crop residues to fuel gas. A review of agricultural statistics indicated that the crop residues wheat straw, corn stover, and rice straw are available in sufficient quantity to provide meaningful supplies of gas. Engineering economic analyses were performed for digestion of wheat straw, corn stover, and rice straw for small farm-, cooperative-, and industrial scales. The small farm scale processed the residue from an average size US farm (400 acres), and the other sizes were two and three orders of magnitude greater. The results of the analyses indicate that the production of fuel gas from these residues is, at best, economically marginal, unless a credit can be obtained for digester effluent. The use of pretreatment can double the fuel gas output but will not be economically justifiable unless low chemical requirements or low cost chemicals can be utilized. Additional development is necessary in this area. Use of low cost hole-in-the-ground batch digestion results in improved economics for the small farm size digestion system, but not for the cooperative and industrial size systems. Recommendations arising from this study are continued development of autohydrolysis and chemical pretreatment of agricultural crop residues to improve fuel gas yields in an economically feasible manner; development of a low cost controlled landfill batch digestion process for small farm applications; and determination of crop residue digestion by-product values for fertilizer and refeed.

33432 (UCRL—84136) **Minimally refined biomass fuels: an economic shortcut.** Pearson, R.K.; Hirschfeld, T.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1980. Contract W-7405-ENG-48. 9p. (CONF-801030—1). NTIS, PC A02/MF A01.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

An economic shortcut can be realized if the sugars from which ethanol is made are utilized directly as concentrated aqueous solutions for fuels rather than by further refining them through fermentation and distillation steps. Simple evaporation of carbohydrate solutions from sugar cane or sweet sorghum, or from hydrolysis of starch or cellulose content of many plants yield potential liquid fuels of energy contents (on a volume basis) comparable to highly refined liquid fuels like methanol and ethanol. The potential utilization of such minimally refined biomass derived fuels is discussed and the burning of sucrose-ethanol-water solutions in a small modified domestic burner is demonstrated. Other potential uses of sugar solutions or emulsion and microemulsions in fuel oils for use in diesel or turbine engines are proposed and discussed.

33433 **Wetland energy crops.** Pratt, D.C.; Andrews, N.J. St. Paul, MN; University of Minnesota (1980). 28p. (CONF-800482—3).

From Bio-energy world congress and exposition; Atlanta, GA, USA (21 Apr 1980).

The use of wetlands to produce biomass crops has been the focus of several research programs at the University of Minnesota. There are over 14 million acres of peatlands in the northern lakes states, Minnesota, Michigan, and Wisconsin. Currently only 2.7% of Minnesota peatlands are utilized for crop production. Typha spp. (cattails), Phragmites communis (reed grass), Carex spp. (sedges), Phalaris arundinacea (reed-canary grass), Alnus spp. (alder) and Salix spp. (willow) are some species being considered as possible wetland energy crops. Typha looks particularly promising; it grows naturally in monocultures, is easily propagated from seed or rhizomes, and is very productive. The total biomass of natural Typha stands often exceeds 40 dry tons/hectare; annual yields from stands

established from rhizome pieces range from 25-30 tons/hectare while stands established with seed yield 8-12 t/ha the first season and 15-20 t/ha by the second season. Studies of harvesting methods, land use considerations, possible environmental constraints, and the overall economics of wetland energy crop production are currently under way.

33434 Potential of cattails as an energy source. Final report. Pratt, D.C.; Bonnewell, V.; Andrews, N.J.; Kim, J.H. St. Paul, MN; University of Minnesota (1980). 150p. (NP—25052).

Research on the feasibility of growing cattails as an energy crop is described. The following topics are included: productivity in natural strands, germination requirements for seed, establishing stands by seeding, rhizome dormancy and development, harvesting and stand establishment, and analysis of canopy structure and radiation profiles in a natural community. (MHR)

33435 Biomass, energy, and nutrient estimation of mixed southern hardwoods. Messina, M.G.; Clark, A.; Phillips, D.; Frederick, D.J.; Gardner, W.E.; Williford, M. Raleigh, NC; North Carolina State University (1979). 8p. (NP—25051).

Nineteen, one-tenth acre (.04 ha) plots were established in mixed, evenaged natural stands of southern hardwoods to sample stand biomass, energy and nutrient contents, and distribution. Stands were located on three site types: bottomland, wet flat, and swamp, and were in the following age classes: 10, 20, 40, and 60 years. Trees were separated by diameter class, component, and were felled. Green weights were determined in the field and samples were collected for laboratory analysis. Data analysis is incomplete at this time, but when completed will show biomass and nutrient distribution in natural hardwood stands and the potential of such stands for biomass and energy production.

33436 Economies in fuel wood supply firms in New Hampshire. Dammann, J.C.; Andrews, R.A. Durham, NH; University of New Hampshire (1979). 27p. (NP—25035).

The cost structure of fuel wood production and marketing firms was studied using a budgetary-type, input-output approach. Costs were found to be influenced greatly by type of yarding machine, differing combinations of equipment to complete the cutting, splitting, loading, and delivery of fuel wood. Farm tractors were lowest cost only at low production levels, crawler tractors were more efficient at relatively short skidding distances, and skidders were more efficient at the longer skidding distances. Cutting logs to stove length with a chain saw was lower cost than with a cordwood saw. Except at very low production levels, a large 4-5 way splitter was always lower cost for splitting. Excluding hand loading, which was always least costly, loading by conveyor, by a small front end loader, and by a large front end loader, respectively, were most efficient as production levels were increased. Delivery costs were found to depend on size of delivery. Substantial economies of scale were experienced in the production system up to a production level of 2000 to 2400 cords output per year with current technology. Above these production levels, adding a second production system becomes the least cost alternative.

33437 Strip selection method of mechanized thinning in northern hardwood pole size stands. Johnson, J.A.; Hillstrom, W.A.; Miyata, E.S.; Shetron, S.G. L'Anse, MI; Michigna Technological University (1979). 15p. (NP—25025).

The purpose of the strip selection thinning was to determine the economic and silvicultural implications of a mechanized harvesting system. The selectively cut strips were thinned from an original basal area of 26.6 square meters per hectare (116 square feet per acre) to a residual of 15.6 square meters per hectare (68 square feet per acre). The 4.57 meter (15 feet) wide clearcut strips reduced the over-all residual stocking to 12.6 square meters per hectare (55 square feet per acre). An average of 193 tons of whole tree chips per hectare (78.1 tons per acre) were removed at a harvesting cost of $8.64 per ton. Thirty-two percent of the residual trees sustained harvesting damage. Of the 32% damaged, 13% were minor injuries [less than 323 square centimeters (50 squae inches) of sapwood exposed] and 19% major injuries [more than 323 square centimeters (50 square inches) of sapwood exposed.

33438 Paraquat and pine trees in east Tennessee. Schnell, R.L.; Toennisson, R.L. Norris, TN; Tennessee Valley Authority (1978). 4p. (NP—25027).

The Tennessee Valley Authority started a series of 8% Paraquat tests in east Tennessee on loblolly, shortleaf, and Virginia pines in the spring of 1974. In addition to species, we are also testing the effects of season of treatment application and the length of time between the completed treatment and the harvest cut. Wood samples are being analyzed by the Botany Department at the University of Tennessee in Knoxville. All three species have shown increased oleoresin production. Season of treatment did not have a significant effect on enhancement nor did length of time between treatment and harvest.

33439 Marketing fuel wood in New Hampshire. Andrews, R.A.; Dammann, J.C. Durham, NH; University of New Hampshire (1978). 25p. (NP—25034).

Emphasis in the study of market structure for fuel wood was placed upon developing information about the market system, current and emerging patterns and constraints. The marketing system for fuel wood has changed, and, based on vendors' comments, will continue to change. Specialization in services performed is developing in which one operator cuts long logs, and delivers to a retailer who processes the wood into ready for stove size sticks. The fuel wood market in 1977 was characterized by a large number of very small volume vendors who in total handled a relatively small amount of wood. Of the 887 vendors, 64% sold 50 cords or less and accounted for only 15% of the fuel wood sold. The fuel wood business is a part-time or minor enterprise for most operators. Vendors' major enterprises or major occupations covered a wide variety of categories which include professionals, unemployed, farmers, loggers, etc., covering 30 occupational classifications. Most of the fuel wood was supplied by firms and persons whose occupational class was associated with wood industries and farms which typically have suitable equipment for handling fuel wood. About 80% of the fuel wood originated from these occupational groups. The average volume handled per vendor even within the same occupational category is a number not particularly useful for policy decisions. Out-of-state sales were relatively minor. About 15% of the fuel wood passed through a middleman; direct sales from producers to consumers was the predominant market channel. By-products of wood milling operations accounted for 15% of fuel wood sales.

33440 Cattails as an energy source. Final report. Pratt, D.C. St. Paul, MN; University of Minnesota (1978). 49p. (NP—25050).

The research accomplished under a project dealing with efforts to determine the feasibility of growing cattails as a crop to collect and store solar energy is described. The 1977 field paddy trials and greenhouse and growth chamber experiments are described. Included is an analysis of the data obtained, and some conclusions based on the information gathered. (MHR)

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 33350, 33351, 33353, 33636, 33637

33441 (AD-A—077112) **The application of dc-dc energy conversion in a solar energy system. Final report.** Tobak, J.P. (Army Armament Research and Development Command, Dover, NJ (USA). Management Information Systems Directorate). Sep 1979. 155p. NTIS, PC A08/MF A01.

Expressions of voltage gain, current, and efficiency are developed for each of five different methods of DC-DC energy conversion. One of the five methods is selected as the design model for a prototype converter to be used in solar energy applications. Both the prototype's performance and the test methods employed are described. Efficiencies as high as 86% are measured along with a constant voltage line regulation of 0.04 volts per volt and a constant voltage load regulation of 0.034 volts per ohm. The prototype acts as a constant 12-volt power supply capable of delivering up to 10-amp currents.

33442 (BNL—51118, pp 51-60) **Systems development activities and photovoltaic concentrator technology.** Schueler, D.G. (Sandia Lab., Albuquerque, NM). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The systems development and definition activities of the DOE photovoltaic program are discussed: the kinds of systems and applications being investigated for potential use in PV power systems; the balance-of-system components, materials, and processes other than the PV collector; and some environmental and health aspects of installing and operating PV power systems. Also, photovoltaic concentrator technology is discussed including the basic concepts; the semiconductor materials and devices being developed or considered for use with concentrators, and the concentrator materials themselves - the reflectors and refractors.

33443 (COO—4094-61) **Snow-covering effects on the power output of solar photovoltaic arrays.** Brench, B.L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Dec 1979. Contract AC02-76ET20279. 30p. NTIS, PC A03/MF A01.

In general, snow covering a photovoltaic panel causes negligible energy loss when the snow is light and melts easily; however, a more serious loss can occur when the snow is heavy and does not quickly melt or shed. In order to examine the effects of snow cover on the output energy available from photovoltaic modules, a small-scale snow-shedding experiment was conducted during the winter of 1978-79 at the Natural Bridges National Monument in Utah. This site was chosen since it was the planned location for a 100-kWp flat-plate photovoltaic power system. Daily array power output and weather

measurements were recorded by a data logger, and time-lapse photographs were taken of the array. The analysis of this data and conclusions concerning the dependence of power loss on type of snow, weather conditions, and panel angle are discussed.

33444 (COO—4094-90) **Handbook for photovoltaic cabling.** Klein, D.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1 Aug 1980. Contract AC02-76ET20279. 122p. NTIS, PC A06/MF A01.

This volume, originally written as part of the Interim Performance Criteria Document Development Implementation Plan and Procedures for Photovoltaic Energy Systems, is an analysis of the several factors to be considered in selecting cabling for photovoltaic purposes. These factors, correspoonding to chapter titles, are electrical, structural, safety, durability/reliability, and installation. A glossary of terms used within the volume is included for reference.

33445 (DOE/ET/20279—100) **Solar photovoltaic systems for residences in the Northeast.** Russell, M.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET20279. 5p. (CONF-801016—2). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Under sponsorship of the US Department of Energy, MIT Lincoln Laboratory is conducting a program to develop residential solar photovoltaic (PV) systems. The first phase of this activity involves the design, construction and testing of four prototype systems at the Northeast Residential Experiment Station. The systems employ roof-mounted photovoltaic arrays of 500 to 800 square feet which provide solar-generated electricity sufficient to cut in half the electrical demand of an energy-efficient, passive-solar residence. Construction of these systems will be complete by December 1980, and will be followed by a one-year test period.

33446 (SERI/TP—611-407) **Future of photovoltaic energy conversion in developing countries.** Hogan, S. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1980. Contract AC02-77CH00178. 52p. NTIS, PC A04/MF A01.

Recent studies reveal that photovoltaic energy conversion will be economically viable for usage in developing countries. An overview of programs designed to lower the costs of such conversion systems is presented. Government goals are reviewed, as well as application projects relative to rural usage. A summary of the state-of-the-art in both advanced research and commercially available technology is presented. It is concluded that with the range of the work being done, such systems will be viable for many rural applications within 5 years.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 33350, 33351, 33353, 33459, 33539, 33540, 33542, 33543, 33546

33447 (DOE/JPL—1060-12(Vol.2), pp 11-27) **Description of the solar thermal program.** Braun, G. 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

Slides used in the talk on DOE's solar thermal power program are reproduced. (WHK)

33448 (DOE/JPL—1060-12(Vol.2), pp 39-46) **Survey of needs for energy storage in a solar thermal electric power plant.** Bruce, R.W. (Aerospace Corp., Los Angeles, CA). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

33449 (DOE/JPL—1060-12(Vol.2), pp 113-121) **Thermal storage requirements criteria for solar power plants interfacing with utility systems.** Melton, W.C. (Aerospace Corp., Los Angeles, CA). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

Solar thermal electric power plants (STEPs) are different from conventional power plants in many ways. However, in the context of this discussion, the single most important distinction is that the solar energy which feeds a STEP is (1) periodic in its availability to the STEP, and (2) not storable or capable of stockpiling before its use, as are coal and oil. The natural response to that is to design a thermal storage system as an integral part of the STEP. The thermal storage system then preserves the received solar energy after its conversion to heat but before its conversion to electric energy at some later time when it is more valuable. The value of the storage must relate to the way it is used. The way it is used must in turn relate to the mode of operation of the STEP in the presence of (a generally larger amount of) conventional generation. Various aspects of the design and use of storage and its value are discussed. A logical case is developed which points toward an increase in storage over and above that which has so far been advocated - but without the concomitant increase in heliostat field size (for a specified turbogenerator nameplate rating).

33450 (DOE/JPL—1060-12(Vol.2), pp 123-137) **Optimal dispatch of storage for solar plants in a conventional electric grid.** Woodard, J.B. (Sandia Labs., Livermore, CA). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

Sandia Laboratories, as technical manager of the advanced central receiver program, is evaluating technologies for solar thermal electric power plants. Solar plants may be designed and evaluated as stand-alone units using plant energy production cost as the figure of merit. But, because insolation and demand for electric power are imperfectly correlated in time, storage unit design and dispatch play key roles in determining the value of a solar electric plant to a conventional electric grid. To find out how grid considerations modify the evaluation and design of solar plants, a storage dispatch algorithm must be developed which considers the load and other plants in the grid. The requirements for such a dispatch algorithm are outlined.

33451 (DOE/JPL—1060-12(Vol.2), pp 169-197) **Value of energy storage for direct-replacement solar thermal power plants.** Anderson, T.D.; Kaplan, S.I.; Wilson, J.V. 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The specific objectives of the study are: (1) to derive cost targets (or what can be afforded) for energy storage systems over a range of applications of direct-replacement solar-thermal power plants; and (2) to determine the amount of energy storage required for a given cost of storage. The utility applications considered are base-load (100% demand factor) and intermediate-load (50% and 25% demand factor). Locations examined are Inyokern, Chicago, and Philadelphia. The analysis procedures and results are described. It is concluded that the value of energy storage is strongly dependent on the cost of the solar steam supply system and on the cost of backup fuel. For a given set of these cost factors, the optimum amount of energy storage is a function of the cost of storage. For the range of cost conditions and power plant locations considered in this study, the maximum amount of storage capacity required was estimated to be 15 kW.hr/kW for a base-load plant located at Inyokern. For intermediate-load plants, the optimum amount of storage capacity was estimated to be less than 6 kW.hr/kW. Other studies indicate that intermediate-load solar power plants have the best economic potential. It is concluded, therefore, that the energy storage R and D program should focus on storage systems of relatively low capacity, i.e., less than 6 kW.hr/kW. (WHK)

33452 (DOE/JPL—1060-31(Vol.2)) **Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1980. Contract AI01-79ET20307. 145p. (JPL-PUB—79-118(Vol.2)). NTIS, PC A07/MF A01.

The main technical activities of the Point-Focusing Thermal and Electric Applications (PFTEA) Project in FY 1979 are documented. During the course of the year, the project's name was changed. It had been the Small Power Systems Applications Project. The present name denotes a realignment of the project's charter and reflects two significant changes: (1) technologies considered will be restricted to point-focusing distributed receiver systems, and (2) the project will be responsible for both thermal and electric applications. This report (Volume II) is a detailed compilation of key activities and results for FY 1979. During FY 1979 significant progress was made in the first engineering experiment, the Small Community Solar Thermal Power Experiment (SCSE), with the completion of the concept definition phase in which three contractors participated - each pursuing a different technology. The PFDR approach with distributed energy conversion (i.e., engine at the focus) was selected as the preferred technology for this first experiment. Procurement activities began in FY 1979 for the Military Module Power Experiment, the first of a series of experiments planned as part of the Isolated Load Series. Both this experiment and the SCSE are discussed in detail. (WHK)

33453 (DOE/JPL—1060-38(Rev.1)) **Electrochemical energy storage systems for solar thermal applications.** Krauthamer, S.; Frank, H. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Mar 1980. Contract AI01-79ET20307. 117p. NTIS, PC A06/MF A01.

Existing and advanced electrochemical storage and inversion/conversion systems that may be used with terrestrial solar-thermal power systems are evaluated. The status, cost and performance of existing storage systems are assessed, and the cost, performance, and availability of advanced systems are projected. A prime consideration is the cost of delivered energy from plants utilizing electrochemical storage. Three broad areas are addressed: (1) the electrochemical, or battery, component of the storage system; (2) the balance of system, or all components other than the battery; and (3)

the overall solar-thermal plant with electrochemical storage. Included in the latter area is a tabulation of the levelized costs of delivered energy from complete plants with sixteen different, advanced electrochemical systems. This tabulation ranks the systems in order of economic attractiveness. The results of the study indicate that the five most attractive electrochemical storage systems are the: iron-chromium redox (NASA LeRC), zinc-bromine (Exxon), sodium-sulfur (Ford), sodium-sulfur (Dow), and zinc-chlorine (EDA).

33454 Contribution of solar energy to the development of arid zones: experience of solar assisted mechanical and electrical systems for industrial and agricultural processes. Clemot, M.G. (SOFRETES, Montargis, France). pp 44-55 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

Examples of applications of solar water pumps in remote arid lands for supplying drinking water for villages and livestock and for irrigation purposes are described. (WHK)

CENTRAL RECEIVER

33455 (DOE/JPL—1060-12(Vol.2), pp 249-266) **Criteria for selection of the thermal storage system for the 10 MW(e) solar power plant to be built in Barstow, California.** Radosevich, L.G. (Sandia Labs., Livermore, CA). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The Department of Energy (DOE) has recently completed the design selection of a 10 MW(e) Solar Central Receiver Power Plant to be built in Barstow, California. The procedure, criteria and methodology used for the selection of the thermal storage subsystem are summarized. Three storage designs were proposed for the 10 MW(e) solar central receiver pilot plant. All designs use the sensible heat concept for storing thermal energy. The designs differ in that they employ various combinations of liquids and solids in series tanks as the storage media. The combinations give rise to different maximum storage temperatures and hence different maximum temperatures of steam produced from storage. (WHK)

TOTAL ENERGY AND HYBRID SYSTEMS

33456 (DOE/JPL—1060-12(Vol.2), pp 139-167) **Thermal storage cost/temperature tradeoffs for Solar Total Energy Systems (STES).** Donabedian, M. (Solar Energy Research Inst., Golden, CO). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The Solar Total Energy System (STES) mission analysis being performed by The Aerospace Corporation involves the identification and selection of appropriate STES applications, economic analysis, and the assessment of industrial market potential. One of the key technical areas involving industrial application is the requirement for high temperature storage, its related cost and its effect on industrial market potential. An analysis of the cost of high temperature sensible heat storage systems in the range of 400°F to 900°F and summary of the effect of storage temperature on STES industrial market potential are presented.

OCEAN THERMAL GRADIENT POWER PLANTS

33457 (ANL/OTEC-PS—6) **OTEC-1 Power System Test Program: test plan for first deployment.** (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 163p. NTIS, PC A08/MF A01.

This report describes in detail all tests planned for the first eight-month deployment of OTEC-1, a test facility constructed by the US Department of Energy in order to test heat exchangers for closed-cycle power plants using ocean thermal energy. Tests to be performed during the first-deployment period are aimed primarily at determining (1) the effectiveness of countermeasures in preventing biofouling of the heat exchanters, (2) the extent of environmental impacts associated with operation of an OTEC facility, and (3) the performance of a 1-MWe, titanium shell-and-tube evaporator and condenser pair. The condenser to be tested has plain tubes, and the evaporator employs the Linde High Flux surface on the working-fluid (ammonia) side to enhance the heat-transfer rate. This plan provides a statement of the objectives and priorities of the test program, describes the test equipment, gives a detailed account of all tests to be performed and the test schedule, and discusses provisions for management of the test program.

33458 (DOE/ET/21002—2) **Report of ad hoc OTEC cold water pipe committee.** Barr, R.; Giannotti, J.; Deuchler, W.; Scotti, R.; Stadter, J.; Walsh, J.P.; Weiss, R. (VSE Corp., Alexandria, VA (USA)). 1 Feb 1980. Contract AC02-78ET21002. 138p. NTIS, PC A07/MF A01.

Now that the design work on the pilot plant is scheduled to start in the near future, DOE has considered it essential that an overall look be taken at the cold water pipe design process. The VSE Corporation, in its role as a support contractor to DOE, was tasked to organize a small study group to answer the question, Where do we stand on the verification of the computer models of the cold water pipe response by experimental measurements. The committee has studied all the available results of the cold water pipe development program. This report summarizes those results. The development and present capabilities of the computer programs used to calculate the response of a cold water pipe attached to a platform under known at-sea conditions are discussed. The various cold water pipe designs that have been done using the computer programs are summarized. The experiments that have been conducted up to the present time to measure the response of cold water pipes at-sea and in experimental tanks are described. The results of these experiments are presented. The experimental results are compared with the predictions made with the analytical computer programs. Conclusions drawn as a result of this analysis are presented and some recommendations are made. (WHK)

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 33512

33459 (ALO—4298-2) **Vegetable oils: liquid coolants for solar heating and cooling applications.** Ingley, H.A. (Florida Univ., Gainesville (USA). Solar Energy Lab.). Feb 1980. Contract AC04-78CS34298. 207p. NTIS, PC A10/MF A01.

It has been proposed that vegetable oils, renewable byproducts of agriculture processes, be investigated for possible use as liquid coolants. The major thrust of the project was to investigate several thermophysical properties of the four vegetable oils selected. Vapor pressures, specific heat, viscosity, density, and thermal conductivity were determined over a range of temperatures for corn, soybean, peanut, and cottonseed oil. ASTM standard methods were used for these determinations. In addition, chemical analyses were performed on samples of each oil. The samples were collected before and after each experiment so that any changes in composition could be noted. The tests included iodine number, fatty acid, and moisture content determination. (MHR)

33460 (TAC-STC—79-004) **Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Mar 1980. 100p. Technology Application Center, Univ. of New Mexico, Albuquerque.

This annotated bibliography covers the following subjects: material properties, flat plate collectors, concentrating collectors, heat pumps, coolers, heat exchangers, solar ponds, distillation, process heat, and irrigation pumps. (MHR)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 33386, 33524, 33545, 33798

33461 (DOE/CS—0127/1) **Passive solar design handbook. Volume one of two volumes. Passive solar design concepts.** (Total Environmental Action, Inc., Harrisville, NH (USA)). Mar 1980. Contract W-7405-ENG-36. 374p. NTIS, PC A16/MF A01.

The following topics are covered: background to passive solar building design; the basics of solar building design; five passive solar heating techniques: direct gain, convective loops, thermal storage walls, thermal storage roofs, and attached sunspaces; passive solar cooling; and new developments for future use. A glossary and bibliography are included. (MHR)

33462 (DOE/CS/30108—T2) **Coordination/management tasks for the IEA and CCMS solar heating and cooling programs.** (TPI, Inc., Beltsville, MD (USA)). 1980. Contract AC02-79CS30108. 11p. NTIS, PC A02/MF A01.

33463 (DOE/CS/30377—1) **Preliminary designs: passive solar manufactured housing. Technical status report.** (National Homes Corp., Lafayette, IN (USA)). 12 May 1980. Contract FC02-80CS30377. 52p. NTIS, PC A04/MF A01.

The criteria established to guide the development of the preliminary designs are listed. Three preliminary designs incorporating direct gain and/or sunspace are presented. Costs, drawings, and supporting calculations are included. (MHR)

33464 (DOE/CS/34412—16) **Solar hot water space heating system. Technical progress report.** Van Dam, T. (Fairbrother and Gunther, Inc., Grand Rapids, MI (USA)). 13 Aug 1979. Contract AC02-77CS34412. 126p. NTIS, PC A07/MF A01.

A retrofit solar heating system was installed on Madison Hall at Jordan College, Cedar Springs, Michigan. The system provides heating and domestic water preheating for a campus dormitory. Freeze protection is provided by a draindown system. The building and solar system, construction progress, and design changes are described. Included in appendices are: condensate trap design, structural analysis, pictures of installation, operating instructions, maintenance instructions, and as-built drawings. (MHR)

33465 (DOE/CS/35363—T1) **Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems.** (Versar, Inc., Springfield, VA (USA); Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)). Mar 1980. Contract AC04-78CS35363. 187p. NTIS, PC A09/MF A01.

This is the final report of a survey and evaluation of insulation materials for use with components of solar heating and cooling systems. The survey was performed by mailing questionnaires to manufacturers of insulation materials and by conducting an extensive literature search to obtain data on relevant properties of various types of insulation materials. The study evaluated insulation materials for active and passive solar heating and cooling systems and for multifunction applications. Primary and secondary considerations for selecting insulation materials for various components of solar heating and cooling systems are presented.

33466 (DOE/EG/34135—10) **Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980.** Ueland, M. (Ueland and Junker, Architects and Planners, Philadelphia, PA (USA)). 19 Jun 1980. Contract FG02-77CS34135. 7p. NTIS, PC A02/MF A01.

A program of applied research has been developed for the design, construction and monitoring of an innovative concept of solar heating and cooling called solar atrium. The solar atrium concept is adaptable to residences and smaller commercial and institutional buildings. It is designed to be constructed of materials and equipment that are economical and readily available. Cost-effectiveness of installation and operation is a primary design objective. The solar atrium is a further development of efforts begun in the 1930's and 1940's to design houses that would obtain a major portion of their heating from the sun. The early solar house experiments proved the benefits of large glazed areas for trapping solar energy. However, they were not equipped to collect and store surplus solar energy, nor were they equipped to control heat losses through glass areas at night or during cloudy days. The solar atrium incorporates the large glass areas of the earlier houses and adds facilities for heat storage and control of heat losses through glass. Progress and plans are outlined.

33467 (DOE/NASA/CR—161485) **Solar space heating for the visitors' center, Stephens College, Columbia, Missouri. Final report.** (Stephens Coll., Columbia, MO (USA). Building and Grounds Dept.). Jun 1980. Contract AB01-77CS34084;AI01-76CS31024. 308p. NTIS, PC A14/MF A01.

This document is the final report of the solar energy system located at the Visitors' Center on the Stephens College Campus, Columbia, Missouri. The system is installed in a four-story, 15,000 square foot building designed to include the college's Admission Office, nine guest rooms for overnight lodging for official guests of the college, a two-story art gallery, and a Faculty Lounge. The solar energy system is an integral design of the building and utilizes 176 Honeywell/Lennox hydronic flat-plate collectors which use a 50% water-ethylene glycol solution and water-to-water heat exchanger. Solar heated water is stored in a 5000 gallon water storage tank located in the basement equipment room. A natural gas fired hot water boiler supplies hot water when the solar energy heat supply fails to meet the demand. The designed solar contribution is 71% of the heating load. The demonstration period for this project ends June 30, 1984.

33468 (DOE/NASA/CR—161491) **Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jun 1980. Contract AI01-76CS31037. 87p. NTIS, PC A05/MF A01.

The Solar Energy System was designed by Fern Engineering Company, Bourne, Massachusetts to provide space heating and domestic hot water preheating for a 1300 square foot single-family residence located in Lansing, Michigan. The Solar Energy System consists of a 278 square foot flat-plate air collector subsystem, a three 120-gallon tank storage subsystem, a 40 gallon domestic hot water tank subsystem, a liquid/air heat exchanger, an energy transport module, pumps, controls and heat transfer medium lines. Natural gas provides the auxiliary energy for the space heating (100,000 Btu/h) and hot water (70,000 Btu/h) subsystems. The system is shown schematically and has five modes of operation. Typical system operation, system operating sequence, performance assessment, system performance, subsystems performance (collector array, storage, hot water, space heating), operating energy, energy savings, and maintenance are discussed. A brief summary of all pertinent parameters is presented.

33469 (DOE/NASA/CR—161507) **Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jul 1980. Contract AI01-76CS31037. 79p. NTIS, PC A05/MF A01.

The Solaron Duffield Solar Energy System was designed to provide 51% of the space heating, and 49% of the domestic hot water (DHW) to a two story 1940 square foot area residence using air as the transport medium. The system consists of a 429 square foot collector array, a 265 cubic foot rock thermal storage bin, heat exchangers, an 80 gallon DHW preheat tank, pumps, blowers, controls, air ducting and associated plumbing. An air-to-liquid heat pump coupled with a 1000 gallon water storage tank provides for auxiliary space heating and can also be used for space cooling. A 52 gallon electric DHW tank using the solar preheated water provides domestic hot water to the residence. The solar system became operational July 1979, and modes of operation are described. (MHR)

33470 (DOE/NASA/CR—161509) **Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jul 1980. Contract AI01-76CS31037. 94p. NTIS, PC A05/MF A01.

The IBM System 4 Solar Energy System was designed to provide 35 percent of the space heating and 62 percent of the domestic hot water (DHW) preheating for a single-family residence located within the United States. The system is a prepackaged unit called the Remote Solar Assembly which has been integrated into the heating and DHW system in a dormitory in Clinton, Mississippi. The system consists of 259 square feet of Solaron 2001 Series flat-plate-air collectors, a rock thermal storage containing 5 1/2 ton of rock, heat exchangers, blowers, a 52 gallon preheat tank, controls, and associated plumbing, two 30 gallon electric water heaters draw water from the preheat tank. A 20 kilowatt, duct mounted, electric heater supplies auxiliary energy. This system which has three modes of system operation was activated September, 1978. A system performance assessment is presented.

33471 (DOE/NASA/CR—161520) **Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming.** (International Business Machines Corp., Huntsville, AL (USA). Federal Systems Div.). Jun 1980. Contract AI01-76CS31037. 87p. NTIS, PC A05/MF A01.

The IBM System 3 Solar Energy System was designed by the Federal Systems Division of IBM in Huntsville, Alabama to provide 46% of the space heating and 80% of the domestic hot water (DHW) for a 1078 square foot retrofit of an existing building used as a residence at the Glendo Reservoir State Park Ranger Station. The system consists of fourteen Sunworks Model LA1001A flat plate liquid collectors (294 square feet), a 1000 gallon hot water storage tank, a 65 gallon electric domestic hot water tank, pumps, heat exchangers, controls, and associated plumbing. Water is the heat transfer medium for this closed volume, passive drain down system. A gas furnace is used for auxiliary space heating energy. The system which became operational in October 1978 has five modes of operation. Performance data for the year of 1979 are presented and assessed.

33472 (HUD-PDR—481) **Site planning for solar access: a guidebook for residential developers and site planners.** Erley, D.; Jaffe, M. (American Planning Association, Chicago, IL; Living Systems, Winters, CA (USA)). Sep 1979. Contract EX-76-A-29-1020-001. 156p. NTIS, PC A07/MF A01.

A guide for developers, site planners, and builders which assists in the design of residential developments for solar access has been compiled. Data included in an evaluation of site selection and analysis are the sun's positions, latitude and topography, atmospheric conditions, existing shading and shading by natural and man-made objects, energy conservation, and site assessment criteria. Criteria reviewed for preliminary site planning include solar access objectives, local regulations, site planning criteria, procedures and an analysis checklist. The relationship of building and site design, building orientation and solar access, and techniques for analyzing solar access are considered. Design strategies to protect solar access include road layout, lot design, open space planning, and siting strategies for single-family detached, low-rise multifamily, and high-rise housing. Other considerations for building orientation include trees, landscaping, and vegetation utilization. Two examples of solar site planning and building orientation are provided.

33473 (IS-M—286) **Operational experiences from the federal solar heating and cooling demonstrations.** Sidles, P.H. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 9p. (CONF-8006115—2). NTIS, PC A02/MF A01.

From Iowa solar operational results conference; Des Moines, IA, USA (20 Jun 1980).

The purpose of the National Solar Heating and Cooling Act of 1974 was to demonstrate the functional and economic feasibility of solar heating and cooling buildings. A broader and more distant goal was to assist with the establishment of a viable solar industry and to achieve a substantial reduction in the use of fossil fuel through

the widespread use of solar heating and cooling. Performance data are currently published monthly by the US Department of Energy for each instrumented site in the national solar heating and cooling demonstration program. As these reports accumulate they provide an ongoing basis for evaluating the performance of solar systems and can be utilized for illustration of many of the lessons learned from operational experience. The general status of the demonstration program and experience gained are discussed. (WHK)

33474 (IS-M—290) **Hodges residence: performance of a direct gain passive solar home in the 1979-1980 heating season.** Hodges, L. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 7p. (CONF-8006115—1). NTIS, PC A02/MF A01.

From Iowa solar operational results conference; Des Moines, IA, USA (20 Jun 1980).

Results are presented for the performance of the Hodges Residence, a direct gain passive solar home in Ames, during the 1978-1980 heating season, its first occupied heating season. Although no night insulation was used on the double-pane south glass, the total auxiliary heat energy was only 41 million Btu gross and 25 MBTU net, amounting, respectively, to 2.9 and 1.8 Btu per square foot per degree-day. These results were for an unusually cloudy heating season, including the cloudiest January in the 21 years of insolation measurements in Ames.

33475 (LA-UR—80-1669) **Study of two passive solar systems containing phase change materials for thermal storage.** Bourdeau, L.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—1). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Two passive storage collector walls using calcium chloride hexahydrate have been tested at Los Alamos during the 1980 winter season. Results are presented, along with a sensitivity study on yearly performances obtained from a validated simulation model. Advantages provided by such a material against classical storage materials are emphasized.

33476 (LA-UR—80-2231) **Determining heat fluxes from temperature measurements made in massive walls.** Balcomb, J.D.; Hedstrom, J.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—12). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

A technique is described for determining heat fluxes at the surfaces of masonry walls or floors using temperature data measured at two points within the wall, usually near the surfaces. The process consists of solving the heat diffusion equation in one dimension using finite difference techniques given two measured temperatures as input. The method is fast and accurate and also allows for an in-situ measurement of wall thermal diffusivity if a third temperature is measured. The method is documented in sufficient detail so that it can be readily used by the reader. Examples are given for heat flow through walls. Annual results for two cases are presented. The method has also been used to determine heat flow into floors.

33477 (LA-UR—80-2236) **Attached sunspace heating performance estimates.** Jones, R.W.; McFarland, R.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—3). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Heating prformance in terms of an annual Solar Savings Fraction (SSF) has been estimated for attached-sunspace (or attached-greenhouse) types of passively solar heated buildings. The estimation method is computer simulation usng sunspace models in the framework of PASOLE, the Los Alamos Scientific Laboratory passive solar energy simulation program. Certain reference designs have been used to provide a first estimate of performance for various locations. The primary emphasis of the present paper is to report estimates of the variations in performance as a result of variations of certain design parameters from their reference values. Design parameters varied include thermal storage volume, thermocirculation vent areas, sunspace-to-living-space well thermal resistance, sunspace infiltration rate, extent of lightweight sunspace objects, glazing tilt, and other sunspace geometry variations.

33478 (LA-UR—80-2266) **Sensitivity of direct gain performance to detailed characteristics of the living space.** Wray, W.O.; Schnurr, N.M.; Moore, J.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801016—9). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

The SUNSPOT code for the analysis of direct gain solar heated buildings has been expanded to allow for either a coarse (Level I) or detailed (Level II) description of interior geometry. The more detailed Level II model was recently completed and validated against test cell data obtained at the LASL solar laboratory. The effect on performance of varying the distribution and solar absorptance of massive and lightweight surfaces has been investigated with the new model, and results are reported.

33479 (LA-UR—80-2268) **Performance of night insulation and selective absorber coatings in LASL test cells.** Hyde, J.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—7). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

During the winter of 1979-1980, the Los Alamos Scientific Laboratory devoted seven test cells to comparing the performance of selective absorber coatings and night insulation on Trombe walls and water walls. The results showed that black chrome performed as well as night insulation on water walls and outperformed night insulation on Trombe walls.

33480 (LA-UR—80-2328) **Natural convective heat transfer through an aperture in passive solar heated buildings.** Weber, D.D.; Kearney, R.J. (Los Alamos Scientific Lab., NM (USA); Idaho Univ., Moscow (USA). Dept. of Physics). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—13). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

The heat transfer through doorways by natural convection has been measured in a similarity model experiment and in two buildings of greatly differing geometry. The heat transfer can be expressed as a simple function of doorway geometry and any one of several temperature differentials.

33481 (LA-UR—80-2330) **Conservation and solar: working together.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-801016—11). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

A methodology is developed for optimally allocating resources between conservation and solar strategies in building design. Formulas are presented for a constrained optimum in which the initial investment is limited. A global optimum procedure is also described in which life-cycle cost is minimized. The procedure is amenable to hand analysis if tables are available which give the Solar Savings Fraction as a function of the Load Collector Ratio for the locality. A numerical example is given.

33482 (NMEI—22) **Passive solar house designs for New Mexico climates. Final report, July 1, 1978-January 31, 1980. Part 1: design manual.** Lumsdaine, M. (New Mexico State Univ., Las Cruces (USA). Physical Science Lab.). Jun 1980. 223p. (EMD—78-2228). New Mexico State Univ., Las Cruces, NM.

Part I, the Design Manual, is a step-by-step guide for passive solar house design, tailored to New Mexico climatic conditions and containing all necessary supporting information: (1) New Mexico climatic data; (2) discussion of passive solar heating methods; (3) factors determining appropriate plan and lot selection; (4) energy conservation; (5) building specifications, including manufacturers' information on window night insulation; (6) thermal storage; (7) design calculation procedures in worksheet format; (8) backup heating; (9) solar water heating; (10) costs, codes and taxes and (11) sources of further information and recommended reading.

33483 (NP—24992) **Passive solar handbook.** Niles, P.W.B.; Haggard, K.L. (California Energy Commission, Sacramento (USA)). 28 Jan 1980. 332p. California Energy Commission, Sacramento.

Definitions and fundamental principles are reviewed. The basic passive system types are presented. The conceptual, analytical, and detail phases of building design are investigated sequentially for most passive types and energy conserving buildings. Additional technical information is included in appendices, including the CALPAS and CALPOND simulation programs. (MHR)

33484 (SERI/RR—431-328) **National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs.** Koontz, R.; Genest, M.; Bryant, B. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 34p. NTIS, PC A03/MF A01.

The Solar Heating and Cooling Demonstration Act of 1974 created a set of activities to demonstrate the potential use of solar heating within a three-year period and of combined solar heating and cooling within a five-year period. This study assesses the Commercial Demonstration Program portion of the activity in terms of its stated goals and objectives. The primary data base was DOE contractor reports on commercial demonstration projects. It was concluded that the program did not provide data to support a positive decision for the immediate construction or purchase of commercial solar systems. However, the program may have contributed to other goals in the subsequent legislation; i.e., research and development

information, stimulation of the solar industry, and more informed policy decisions.

33485 (SOLAR/1001—80/50) **Solar project description for Moulder Corporation single family residence, Greenwood, Indiana.** (Boeing Co., Seattle, WA (USA)). 17 Jul 1980. Contract AB01-76CS31020. 47p. NTIS, PC A03/MF A01.

The Moulder Corporation solar energy system (Grant H-2754), is installed in a 1769 square-foot, three bedroom single family dwelling located in Greenwood, Indiana. The system is designed to provide solar energy for space heating and domestic hot water heating. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 704 square feet. The array faces 5.5 degrees west of south at an angle of 45 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage, space heating and hot water loads. Solar energy is stored underground in 945-cubic-foot bin containing 81,000 pounds of crushed rock. The bin has 8-inch concrete block walls and the insulation on the exterior is sprayed urethane. Preheated city water is stored in an 80-gallon preheat tank, which is inside the storage bin and is supplied, on demand, to a conventional 52-gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, a conventional electric furnace provides the auxiliary energy for space heating. An electrical heating element in the DHW tank provides auxiliary energy for the hot water load. The dwelling has been fully instrumented for performance evaluation since September 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given.

33486 (SOLAR/1012—80/50) **Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland.** (Boeing Co., Seattle, WA (USA)). 11 Apr 1980. Contract AB01-76CS31020. 55p. NTIS, PC A04/MF A01.

The J.D. Evans, Inc. (House A) solar energy system (Grant H-2718) is installed in a 2250 sq ft house located in Columbia, Maryland. The system is designed to provide solar energy for space heating and domestic hot water. Solar energy is collected by an array of fourteen (14) flat plate collectors with a gross area of 326 square feet. The 14 collectors are mounted on the roof of the house and face due south, at an angle of 45 degrees to the horizontal optimizing solar energy collection. Solar energy is transferred from the collector array to a 1000 gal storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by drain-down of collectors. Space heating demands are met by circulating hot water from storage through heating ducts in the air distribution system of the house. Auxiliary space heating is provided by a heat pump and electrical heating element. An electrical heating element provides auxiliary energy for water heating. The dwelling has been fully instrumented for performance evaluation since February 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given; however, the final solar system cost and the cost of its instrumentation are not included.

33487 (SOLAR/1024—80/50) **Solar project description for the College Houses student co-op apartments, Austin, Texas.** (Boeing Co., Seattle, WA (USA)). 10 Jul 1980. Contract AB01-76CS31020. 57p. NTIS, PC A04/MF A01.

The College Houses solar energy system (Grant H-2771) is installed in an 80 unit low-rise student apartment located in Austin, Texas. The system is designed to provide solar energy for space heating, cooling, and preheating domestic hot water. Solar energy is collected by 228 collector panels occupying a gross area of 2280 square feet. The collector banks are mounted on the roof of the building and automatically track the sun for optimizing solar energy collection. Solar energy is transferred from the collector array to a 6,000 gallon storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by an air-bleed drain down system. Space heating demands are met by circulating water from storage through heat exchangers in the air distribution system of the house. Auxiliary space heating is provided by a boiler. The system has been fully instrumented for performance evaluation since October 1, 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given. The final solar system cost and the cost of its instrumentation are not included.

33488 (SOLAR/1029—80/50) **Solar project description for Design Construction Association single family dwelling, Big Fork, Montana.** (Boeing Co., Seattle, WA (USA)). 4 Apr 1980. Contract AB01-76CS31020. 62p. NTIS, PC A04/MF A01.

The Design Construction Association solar energy system (Grant H-2786) is installed in an 2100 sq ft house located in Big Fork, Montana. The system is designed to provide solar energy for heating and domestic hot water. Solar energy is collected by flat plate collectors with a gross area of 792 square feet. The collector banks are mounted on the roof of the house and face due south at an angle of 45 degrees to the horizontal optimizing solar energy collection. Solar energy is transferred from the collector array to a 1500 gallon storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by use of a drain down system. Space heating demands are met by circulating hot water from storage through baseboard units in the distribution system of the house. Auxiliary space heating is provided by an electricl heating element in the boiler. Similarly, an electrical heating element in the DHW tank provides energy for water heating. The dwelling has been fully instrumented for performance evaluation since October 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given; however, the final solar system cost and the cost of its instrumentation are not included in this report.

33489 **Solar systems for heating and cooling.** Feruglio, M. (Gruppo Ricerca e Sviluppo, Pordenone, Italy). pp 61-72 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

Four solar systems in Italy which use the Zanussi flat plate collector are briefly described. Systems include the solar water heater at Sesegana, the solar absorption air conditioning system at Porcia, the solar space heating system at the school building in Marostica, and the solar space heating system at Fiume Veneto. Automatic data collecting systems for the installations are discussed. (WHK)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 33452

33490 **Solar energy for industry.** London, England; UK-ISES (1978). 99p. (CONF-780295—).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

Separate abstracts were prepared for the 10 papers presented. (WHK)

33491 (DOE/SF/10606—1/1) **Solar industrial retrofit system for the Provident Energy Company refinery. Section 1: executive summary. Final report, September 28, 1979-July 15, 1980.** (Foster Wheeler Corp., Livingston, NJ (USA)). 15 Jul 1980. Contract AC03-79SF10606. 30p. NTIS, PC A03/MF A01.

Foster Wheeler Development Corporation (FWDC) is under contract to the Department of Energy (DOE) to prepare a conceptual design of a solar-powered steam generating system for a 92 dm^3/s (50,000 barrels per day) crude oil refinery to be constructed near Phoenix, Arizona, for the Provident Energy Company, Inc. The refinery is scheduled for operation in 1984, with a planned average steam load of 21.4 kg/s (170,000 lb/h). The conceptual design incorporates a second generation heliostat, a flat-panel receiver, a fossil-fired superheater, and a steam accumulator to supply the refinery with 4.14 MPa gage (600 lb/in^2g) and 370°C (700°F) superheated steam. This solar steam generating system will operate in parallel with the refinery boilers to supply 20% of the steam needed annually by the refinery. This system will be the world's largest retrofit industrial solar steam system. An executive summary of the project is provided in this volume.

33492 (DOE/SF/10606—1/2) **Solar industrial retrofit system for the Provident Energy Company refinery. Sections 2-8. Final report, September 28, 1979 to July 15, 1980.** Raghavan, R. (Foster Wheeler Corp., Livingston, NJ (USA)). 15 Jul 1980. Contract AC03-79SF10606. 222p. NTIS, PC A10/MF A01.

The conceptual design of a solar-powered steam generating system for a 92 dm^3/s (50,000 barrels per day) crude oil refinery to be constructed near Phoenix, Arizona, is described in detail. The refinery is scheduled for operation in 1984, with a planned average steam consumption of 21.4 kg/s (170,000 lb/h) on an annual basis. The conceptual design incorporates a second generation heliostat, a flat-panel receiver, a fossil-fired superheater, and a steam accumulator to supply the refinery with 4.14 MPa gage (600 lb/in^2g) and 371°C (700°F) superheated steam. This solar steam generating system will operate in parallel with the refinery boilers to supply 20% of the steam needed annually by the refinery. Results from the conceptual design study show that the use of solar energy to generate process steam is entirely feasible, that there are no problems technically or with hardware, and that a positive rate of return on investment can be achieved. The oil saved at this medium-sized refinery is 76,700 barrels/yr - equivalent to $2 million at the current oil price. An economic analysis and development plan are included.

33493 (DOE/SF/10606—1(App.)) **Solar industrial retrofit system for the Provident Energy Company refinery. Appendices to final report, September 28, 1979 to July 15, 1980.** (Foster Wheeler

Corp., Livingston, NJ (USA)). 15 Jul 1980. Contract AC03-79SF10606. 168p. NTIS, PC A09/MF A01.

The conceptual design of a solar tower focus steam generating system for a crude oil refinery to be constructed near Phoenix, Arizona, is presented. This volume of the report contains the appendices: (A) system requirements specifications; (B) trade-off studies; (C) failure modes and effects analysis; and (D) instrumentation symbols and identification and piping material specifications. (WHK)

33494 (DOE/SF/10608—1) **Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor uranium mill solar retrofit. Final technical report.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Jun 1980. Contract AC03-79SF10608. 281p. NTIS, PC A13/MF A01.

This report covers the efforts in a nine month study to develop a site-specific conceptual design for solar tower focus collector industrial retrofit of the Gulf Mt. Taylor Uranium Mill. This has resulted in preparation of a System Requirements Specification, conduct of trade studies leading to selection of a system concept, and conceptual design, performance, cost estimating and economic analysis of the selected concept. A baseline system with no storage and an alternative system with extended storage were evaluated. The baseline system with no storage was selected because it provides the best overall opportunity for fuel displacement, operating experience in industrial application and successful demonstration in the near term for both DOE and the User. This volume contains details of the conceptual design, subsystem characteristics, economic analysis, and development plan.

33495 (DOE/SF/10608—(Exect.Summ.)) **Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report, executive summary.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Jun 1980. Contract AC03-79SF10608. 26p. NTIS, PC A03/MF A01.

This report covers the efforts in a nine month study to develop a site-specific conceptual design for solar industrial retrofit of the Gulf Mt. Taylor Uranium Mill. This has resulted in preparation of a System Requirements Specification, conduct of trade studies leading to selection of a system concept, and conceptual design, performance, cost estimating and economic analysis of the selected concept. A baseline system with no storage and an alternative system with extended storage were evaluated. The baseline system with no storage was selected because it provides the best overall opportunity for fuel displacement, operating experience in industrial application and successful demonstration in the near term for both DOE and the user. This volume contains the executive summary.

33496 (DOE/SF/10736—1/1) **Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Executive summary. Final report.** (Northrup, Inc., Hutchins, TX (USA); ARCO Oil and Gas Co., Bakersfield, CA (USA)). Jul 1980. Contract AC03-79SF10736. 57p. NTIS, PC A04/MF A01.

Work on the project to develop a site-specific conceptual design for a practical and cost-effective solar retrofit system to supply process heat for a representative petroleum industry application is summarized. The application selected for the project is the processing of natural gas to: (1) extract natural gas liquids and produce propane, butane and gasoline from them; and (2) condition the residue natural gas for marketing. The process requires heat in the 193 to 304°C (380 to 580°F) range which is readily achievable with concentrating solar thermal systems. The application is also ideal for solar retrofit because many natural gas processing plants utilize a heat transfer oil which permits an extremely simple interface with the fired oil heaters normally used. The solar retrofit conceptual design was developed for the ARCO Oil and Gas Company's North Coles Levee Natural Gas Processing Plant No. 8 located near Bakersfield, California. This plant uses gas-fired heaters and gas turbine exhaust heat to heat oil which is then cascaded through a series of reboilers thus supplying process heat at several required temperatures.

33497 (DOE/SF/10736—1/2) **Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Technical report. Final report.** (Northrup, Inc., Hutchins, TX (USA); ARCO Oil and Gas Co., Bakersfield, CA (USA)). Jul 1980. Contract AC03-79SF10736. 385p. NTIS, PC A17/MF A01.

The conceptual design, economic analysis, and development plan for the solar retrofit system for the ARCO Oil and Gas Company's North Coles Levee Natural Gas Processing Plant No. 8 located near Bakersfield, California are presented in detail. The solar system is composed of four major subsystems: the collector, the receiver, the tower, and the receiver loop. Characteristics of each of these subsystems are elaborated. (WHK)

33498 (DOE/SF/10736—1/3) **Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Appendices. Final report.** (Northrup, Inc., Hutchins, TX (USA); ARCO Oil and Gas Co., Bakersfield, CA (USA)). Jul 1980. Contract AC03-79SF10736. 322p. NTIS, PC A14/MF A01.

The conceptual design of the solar tower focus retrofit system for ARCO Oil and Gas Company's North Coles Levee Natural Gas Processing Plant No. 8 located near Bakersfield, California, is presented. This volume of the report contains the appendices: (A) system requirements specification; (B) environmental impact assessment; (C) heliostat performance; (D) solar flux maps; (E) receiver thermal performance maps; (F) selective surface finish vs black paint trade off study; and (G) collector trade data. (WHK)

33499 (DOE/SF/10737—1) **Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report.** (Martin Marietta Corp., Denver, CO (USA)). Jul 1980. Contract AC03-79SF10737. 307p. (MCR—80-1353). NTIS PC A14/MF A01.

A conceptual design of a solar thermal-enhanced oil recovery system for Exxon's Edison oil field near Bakersfield, California, is described in detail. The tower focus collector field consists of 818 heliostats with a reflective area of 528 ft². An economic analysis and development plan are included. Appendices include (A) Bakersfield climatological data, (B) receiver cavity heat flux characteristics, and (C) requirements system specification. (WHK)

33500 (DOE/SF/10737—1(Exect.Summ.)) **Solar Repowering/Industrial Retrofit Systems, Category B: Solar Thermal-Enhanced Oil Recovery System.** (Martin Marietta Corp., Denver, CO (USA)). Jul 1980. Contract AC03-79SF10737. 22p. (MCR—80-1352). NTIS, PC A02/MF A01.

A summary of the conceptual design, performance, economics, and development plan for a central receiver solar thermal system for a thermal-enhanced oil recovery process in Exxon's Edison oil field near Bakersfield, California is given. When installed and operational, this system will displace the consumption of 6,852 m³ [43,000 barrels] of oil per year.

33501 (DOE/SF/10742—1(Exec.Summ.)) **United States Gypsum Plant Solar Retrofit Program.** (United States Gypsum Co., Sweetwater, TX (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Jul 1980. Contract AC03-79SF10742. 24p. NTIS, PC A02/MF A01.

A conceptual design of a solar retrofit to US Gypsum's plant at Sweetwater, Texas, has been developed which provides heated air to a large gypsum board drying kiln that is currently under construction. The solar heated air displaces natural gas normally used for the process heat. The solar retrofit is composed of a tower focus collector with a cavity receiver which uses air as the heat transfer fluid. An executive summary of the conceptual design, system performance, economics, and development plan is presented. (WHK)

33502 (DOE/SF/10742—1(Vol.1)) **United States Gypsum Plant Solar Retrofit Program. Final report.** (United States Gypsum Co., Sweetwater, TX (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Jul 1980. Contract AC03-79SF10742. 153p. NTIS, PC A08/MF A01.

The objective of the United States Gypsum Plant Solar Retrofit Program was to develop a conceptual design of a system to supply solar-heated process air to a gypsum board drying kiln operated by the United States Gypsum Company at its Sweetwater, Texas plant. The specific objectives of the conceptual design study activities were to: (1) provide practical and effective use of solar energy as a process heat alternative to firing natural gas for drying wallboard; (2) be constructed and operational by 1985; (3) make maximum use of existing solar thermal technology; and (4) provide the best possible economics for the overall Sweetwater operation. The technical approach employed during the program was to make selections, in sequence, of the US Gypsum manufacturing facility, process, specific process application, the solar concept, the interfaces, general retrofit configuration, and specific retrofit components. Then, the conceptual design was performed, operational sequence determined, and performance defined. Finally, costs were estimated for construction and operation and combined with savings (performance) of natural gas and power to produce the economic analyses for the solar retrofit plant. The detailed conceptual design, subsystem characteristics, economic analysis, and development plan are given. The preferred system consists of a cavity receiver tower focus collector system. (WHK)

33503 (DOE/SF/10742—1(Vol.2)) **United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification.** (United States Gypsum Co., Sweetwater, TX (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Jul 1980. Contract AC03-79SF10742. 85p. NTIS, PC A05/MF A01.

This specification defines the characteristics, requirements, and economic data for a Solar Industrial Retrofit Plant to supply process heat to a kiln used to dry gypsum board at the United States Gypsum Company plant at Sweetwater, Texas. The specification is limited (1) to those portions of the plant to be added or modified to accomplish the solar retrofit, and (2) by the conceptual design nature of the contracted study. The solar retrofit system, its components and nomenclature are described. Listings of applicable standards and

codes, publications, reference documentation, and regulatory information are provided. Design and performance requirements to be met by the solar retrofit plant and the environmental criteria applicable to the plant are included. The solar retrofit plant's characteristics and performance data are specified along with the plant cost and economic data.

33504 (SERI/RR—632-702) **SERAPH facility capabilities.** Castle, J.; Su, W. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-77CH00178. 56p. NTIS, PC A04/MF A01.

The SERAPH (Solar Energy Research and Applications in Process Heat) facility addresses technical issues concerning solar thermal energy implementation in industry. Work will include computer predictive modeling (refinement and validation), system control and evaluation, and the accumulation of operation and maintenance experience. Procedures will be consistent (to the extent possible) with those of industry. SERAPH has four major components: the solar energy delivery system (SEDS); control and data acquisition (including sequencing and emergency supervision); energy distribution system (EDS); and areas allocated for storage development and load devices.

33505 **Potential for industrial use of solar energy in the United Kingdom.** Brinkworth, B.J.; Lewis, T.T. (University Coll., Cardiff, England). pp 1-17 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

A brief survey is given of the output that might be expected from solar thermal collection systems operated in the UK and the opportunities for linking these with loads in the industrial, commercial, and public service sectors. It is seen that much more detailed studies are required if the potential use of solar energy in these sectors is to be properly quantified.

33506 **Solar tobacco drying plant.** Cuozzo, L. (CTIP Solar SpA, Rome, Italy). pp 56-58 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

The solar tobacco drying plant in Pistrino, Umbria, which has been operational since August 1977 is briefly described. The dryer employs parabolic trough collectors and a water-to-air heat exchanger. (WHK)

33507 **Analysis of the economic potential of solar thermal energy to provide industrial process heat in the United States.** Szego, G.C.; Fraser, M.D. (InterTechnology/Solar Corp., Warrenton, VA). pp 73-81 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

A study was done for the Department of Energy (DOE) to analyze the potential applications of solar thermal energy to provide process heat for industry in the United States. One of the major tasks was to identify, summarize, and compare the important characteristics, including performance and cost, of various solar thermal energy systems pertinent to their use as providers of industrial process heat. Another task was to develop an industrial process heat data base with the required amount of detail on temperature ranges, forms of heat, and amounts of heat used in specific applications in specific processes. These were analyzed to identify process heat applications of solar energy which are technically and economically feasible. The variables considered in this assessment included climatic region, geographical distribution of process heat requirements, competing fuels, and particular points in time - 1976, 1985, and 2000. This quantitative assessment of the potential of solar thermal energy systems to provide industrial process heat indicated that solar has a maximum potential to provide 0.6 quadrillion Btu (0.6 quadrillion kJ) per year in 1985, and 7.3 quadrillion Btu (7.7 quadrillion kJ) per year in 2000 in economic competition with the projected costs of conventional fossil fuels - for applications having a maximum required temperature of 550°F (288°C). This potential can be increased significantly with an appropriate tax credit such a a tax deduction for fossil fuel saved.

33508 **US Government appraisal of the potential of solar energy for industry.** Spongberg, R.C. (Dept. of Energy, Washington, DC). pp 82-95 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

The high energy consumption in the industrial sector suggests that it may be an area where significant contributions can be made by conservation and solar technologies. A number of studies have been undertaken to assess the economic potential of solar thermal energy systems to provide an alternative to the industrial sector for process heat applications. The findings of these studies are reviewed and concludes that solar energy can be an effective energy alternative to the industrial community by the end of this century if the right economic and tax structure conditions prevail.

WATER HEATING

REFER ALSO TO CITATION(S) 33386, 33464, 33468, 33469, 33470, 33471, 33484, 33485, 33486, 33487, 33488, 33489

33509 (DOE/NASA/CR—161512) **Solar energy system economic evaluation: final report for SEMCO-Loxahatchee, Loxahatchee National Wildlife Refuge, Palm Beach County, Florida.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jul 1980. Contract AI01-76CS31037. 99p. NTIS, PC A05/MF A01.

The economic analysis of the solar energy system that was installed at Loxahatchee, Florida Operational Test Site (OTS) is developed for Loxahatchee and four other sites typical of a wide range of environmental and economic conditions in the continental United States. This analysis is accomplished based on the technical and economic models in the f-Chart design procedure with inputs based on the characteristics of the installed system and local conditions. The results are expressed in terms of the economic parameters of present worth of system costs over a projected twenty year life, life cycle savings, year of positive savings and year of payback for the optimized solar energy system at each of the analysis sites. The sensitivity of the economic evaluation to uncertainties in constituent system and economic variables is also investigated. The results demonstrate that the solar energy system is economically viable at all of the five sites for which the analysis was conducted.

33510 (NP—25017) **Solar energy economics for the county of Santa Barbara.** Doctor, R.D. (California Energy Commission, Sacramento (USA)). Sep 1979. 78p. California Energy Commission, Sacramento, CA.

Economic analyses of domestic solar water heating for single and multi-family homes and pool heating for the County of Santa Barbara are presented. The Solar Finance life cycle cost computer program (SOLFIN) developed at the California Energy Commission has been used to develop cost comparisons of solar and competing conventional systems. Key assumptions were varied to determine the degree to which basic results might be altered. These key assumptions include: fuel price escalation rates, fraction of conventional fuel displaced by solar, maintenance cost; solar equipment installed cost, inflation rate, and discount rate. In addition, analyses were developed to examine the linkage between inflation rate and the mortgage rate, fuel price escalation rates and the consumer's discount rate. To assist in formulating appropriate governmental policies regarding the development of new energy supplies, the cost of solar (a new energy supply) was compared to the cost of owning and operating conventional systems using natural gas or electricity priced at the cost of new sources of these energy forms. Results are presented and discussed. (WHK)

OTHER

33511 **Analysis of a Cassegrain solar furnace.** Cobble, M.H.; Hull, W.C.; Hays, R.A. (New Mexico State Univ., Las Cruces). pp 55-63 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

A solar furnace consisting of a paraboloid of revolution which tracks the sun and relfects radiation to a hyperboloid of revolution having a common focus with the paraboloid is analyzed to determine the concentration available, using various eccentricities. The hyperboloid, in turn, reflects radiation to a focal plane placed at various distances from the vertex of the paraboloid. The ideal concentration is determined using the largest radius of all the rays from the sun falling on the paraboloid, this radius being the distance from the pierce point of the ray, in the focal plane, to the hyperboloid focal point. The concentrations can be augmented using a compound paraboloidal concentrator, and the ideal augmented concentration is developed for various combinations of eccentricity and vertex distances. The effect of scattering angles for the paraboloid and hyperboloid on the ideal concentration is shown separately and jointly.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 33460, 33465, 33490, 33511

33512 (AD-A—076836) **Solar energy design improvement: a methodology for hydronic flat plate collector systems.** Kozoyed, L.W. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1979. 235p. Availability: Microfiche copies only.

Thesis.

A methodology for solar energy system design improvement has been developed and coupled with a constrained function optimization code resulting in an automated solar energy system design procedure. The scope of the methodology is limited to systems using flat plate collectors and water as the working fluid. Eight parameters have been inlcuded as independent design variables. The design variables included collector area, collector tile angle, collector and storage fluid stream velocities, and collector to storage heat exchanger dimensions. The procedure includes an accounting for economic parameters as an intimate part of the design process. The resulting methodology has been used for the design of solar energy systems which would use shelf item collectors for the purpose of determining the optimum design variable vector for a given situation. The methodology could also be used on a limited basis for collector design optimization by exploring the effects of changing selected collector parmeters on system performance. The methodolgoy is coded in the FORTRAN computer language under the name SOLOAD-1 (Solar Energy Optimization Analysis or Design).

33513 (ALO—2032-2) **Further development of a low-cost solar panel. Final report, September 28, 1979-May 31, 1980.** Muller, T.; Torok, R.; Erskine, D.; Short, R. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Jul 1980. Contract AC04-79AL12032. 81p. NTIS, PC A05/MF A01.

The primary objective of this project was to fabricate, test, and gain practical operational experience on a full-scale prototype panel section, with emphasis on the unglazed configuration. The project included design refinement, fabrication of full-scale prototypes by hand and semiautomated equipment, subscale and full-scale structural testing, outdoor performance tests, and an assessment of manufacturing requirements and production costs. The Low Cost Solar Panel, the project approach, and the more significant accomplishments of this contract are described in detail.

33514 (DOE/CS/10510—T9) **Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report.** Diegle, R.B. (Battelle Columbus Labs., OH (USA)). 11 Apr 1980. Contract AC04-79CS10510. 67p. NTIS, PC A04/MF A01.

Corrosion measurements were made on candidate alloys of construction for non-concentrating solar collectors under simulated conditions of collector operation. Materials evaluated were aluminum alloys 1100, 3003, and 6061, copper alloy 122, Type 444 stainless steel, and 1018 plain carbon steel. The solutions used were equivolume mixtures of ethylene glycol and water, and propylene glycol and water. They were used without corrosion inhibitors but with addition of chloride, sulfate, and bicarbonate ions. The influences of dissolved oxygen, solution flow velocity, and heat transfer were evaluated. Corrosion morphologies investigated were general attack, pitting, crevice corrosion, and galvanic corrosion. Experimental results indicated that aluminum alloys can experience severe pitting and crevice corrosion at chloride concentrations approaching 50 ppM. The corrosion rate of copper exceeded about 100 μm/yr in ethylene glycol solutions and about 80 μm/yr in propylene glycol solutions. Crevice corrosion was not observed for copper, but severe galvanic corrosion occurred when it was coupled to T444 stainless steel. T444 steel corroded at rates of less than 1 μm/yr under all exposure conditions. During circulation at 100 C in the presence of air, ethylene glycol solutions acidified because of degradation of the glycol. The initial pH of propylene glycol solutions was already low, about 4.5. The inherent corrosivity of propylene glycol was somewhat less than that of ethylene glycol, although this difference was usually less than a factor of two in measured corrosion rates. It was concluded that he corrosion rates of aluminum alloys and copper were prohibitively high in uninhibited glycol solutions, and that corrosion inhibitors are definitely necessary in operating systems.

33515 (DOE/CS/10510—T10) **Determination of interaction between different waters and chemical antifreeze additives. Task 3 of solar collector studies for solar heating and cooling applications. Final technical progress report.** Beavers, J.A.; Salmons, L.A.; Diegle, R.B. (Battelle Columbus Labs., OH (USA)). 11 Apr 1980. Contract AC04-79CS10510. 75p. NTIS, PC A04/MF A01.

Chemical degradation of aqueous glycol solutions was monitored during stagnant exposure at temperatures of 100 C and 180 C. Changes in corrosivity of the solutions toward alloys of construction in solar collectors were also determined. The solutions consisted of equivolume mixtures of reagent grade ethylene glycol and water, and propylene glycol and water. The water was either distilled/deionized, or a mildy corrosive solution containing 100 ppM each of chloride, sulfate, and bicarbonate ions. The solutions were exposed with and without contact with metals, these metals being unalloyed copper (CA 122), 1018 steel, and aluminum alloys 1100, 3003, and 6061. Either air or nitrogen was purged through the solutions at 100 C, whereas for solutions at 180 C the autoclave head space was filled with air or nitrogen prior to sealing the autoclave. Degradation was measured by noting changes in solution pH and accumulation of organic acids during prolonged elevated temperature exposures. Changes in corrosivity were measured in terms of weight loss, polarization resistance, and pit depth on metal coupons suspended in the solutions during exposure.

33516 (DOE/CS/10510—T11) **Corrosion problems with aqueous coolants, final report.** Diegle, R.B.; Beavers, J.A.; Clifford, J.E. (Battelle Columbus Labs., OH (USA)). 11 Apr 1980. Contract AC04-79CS10510. 224p. NTIS, PC A10/MF A01.

The results of a one year program to characterize corrosion of solar collector alloys in aqueous heat-transfer media are summarized. The program involved a literature review and a laboratory investigation of corrosion in uninhibited solutions. It consisted of three separate tasks, as follows: review of the state-of-the-art of solar collector corrosion processes; study of corrosion in multimetallic systems; and determination of interaction between different waters and chemical antifreeze additives. Task 1 involved a comprehensive review of published literature concerning corrosion under solar collector operating conditions. The reivew also incorporated data from related technologies, specifically, from research performed on automotive cooling systems, cooling towers, and heat exchangers. Task 2 consisted of determining the corrosion behavior of candidate alloys of construction for solar collectors in different types of aqueous coolants containing various concentrations of corrosive ionic species. Task 3 involved measuring the degradation rates of glycol-based heat-transfer media, and also evaluating the effects of degradation on the corrosion behavior of metallic collector materials.

33517 (DOE/CS/10510—T12) **Review of state-of-the-art of solar collector corrosion processes. Task 1 of solar collector studies for solar heating and cooling applications. Final technical progress report.** Clifford, J.E.; Diegle, R.B. (Battelle Columbus Labs., OH (USA)). 11 Apr 1980. Contract AC04-79CS10510. 183p. NTIS, PC A09/MF A01.

The state-of-the-art of solar collector corrosion processes is reviewed, and Task 1 of a current research program on use of aqueous heat transfer fluids for solar heating and cooling is summarized. The review of available published literature has indicated that lack of quantitative information exists relative to collector corrosion at the present time, particularly for the higher temperature applications of solar heating and cooling compared to domestic water heating. Solar collector systems are reviewed from the corrosion/service life viewpoint, with emphasis on various applications, collector design, heat transfer fluids, and freeze protection methods. Available information (mostly qualitative) on collector corrosion technology is reviewed to indicate potential corrosion problem areas and corrosion prevention practices. Sources of limited quantitative data that are reviewed are current solar applications, research programs on collector corrosion, and pertinent experience in related applications of automotive cooling and non-solar heating and cooling. A data bank was developed to catalog corrosion information. Appendix A of this report is a bibliography of the data bank, with abstracts reproduced from presently available literature accessions (about 220). This report is presented as a descriptive summary of information that is contained in the data bank.

33518 (DOE/CS/30218—1) **Model validation and sensitivity analysis of solar collector loops. Final technical report.** (Middlebury Coll., VT (USA)). 30 Jul 1980. Contract AC03-80CS30218. 18p. NTIS, PC A02/MF A01.

The experimental solar collector systems at Middlebury College have been modified to permit short time resolution studies of solar collector loop performance. A variety of experiments have been performed to measure the following system properties: (a) collector efficiency, (b) collector response to step changes in insolation, (c) collector response to the introduction of cold inlet water, and (d) pump cycling as a function of control sensor location and set points. Data from these experiments have been supplied to the solar group at Drexel for validation of their analytical collector loop model.

33519 (LA-UR—80-2329) **Development of an experimental test apparatus for natural convection solar collectors.** Morris, W.S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—10). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

An experimental test apparatus built at the Los Alamos Scientific Laboratory to obtain a broad experimental data base on natural convection solar collectors is described. As construction of the apparatus was completed in late February 1980, and shakedown testing was conducted during late winter, a brief evaluation of system performance and preliminary test results are presented.

33520 (NBS-BSS—117) **Experimental verification of a standard test procedure for solar collectors.** Hill, J.E.; Jenkins, J.P.; Jones, D.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jan 1979. Contract AT01-77CS36010. 134p. NTIS, PC A07/MF A01.

A proposed procedure for testing and rating solar collectors based on thermal performance was published by the National Bureau of Standards (NBS) in 1974. Subsequently, the American Society of Heating, Refrigerating, and Air Conditioning (ASHRAE) developed a modified version of the NBS procedure which was adopted in early 1977 as ASHRAE Standard 93-77. A test facility for water-heating and air-heating collectors has been built at NBS and was used to support the development of Standard 93-77. The purpose of this report is to describe the recently adopted test procedure, the NBS test facility, and the tests that were conducted to support the development of the procedure.

33521 (SERI/TR—334-601) **Polymers in solar technologies: an R and D strategy.** Carroll, W.F.; Schissel, P. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 37p. NTIS, PC A03/MF A01.

The use of polymers can increase the cost-effectiveness of solar technologies. The potential impact of polymers may be enhanced earlier if R and D is carried out according to a plan. The purpose of this plan is to present a five-year program consisting of 20 tasks categorized into six major problem areas: response to combined stresses; photochemistry; permeability/adhesion; surface properties; mechanical properties; and development of polymers. A budget required for each task is estimated and summarized for each problem area. It is shown that the potential future impact of polymers on the economics of solar technologies justifies the proposed expenditures.

33522 (UCID—18764) **Open-loop heliostat reflector.** Koide, G.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

A microcomputer controlled heliostat driven in an elevation/azimuth gimbal arrangement with simple shaft encoders can reflect a sunlight beam to within +-two inches vertically and +-one inch horizontally at a distance of seven feet from the target, which corresponds to an arc of +-1.5°. To minimize the error in tracking, the reflector should be aligned as accurately as possible with the north-south axis, with a transit or solar noon.

33523 High temperature collector systems and report on integrated systems for cooling, desalination, and power generation. Posnanski, M. (Polisolar SA Ltd., Bern, Switzerland). pp 18-29 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

Polisolar Ltd. has developed several concentrating collector systems based on the same concept. A variable number of cylindrical parabolic collector (mirror) elements are arranged within a modular structure and coupled to a common solar sensor and tracking mechanism. In the focal line of each collector element a fixed tubular receiver is inter-connected with a common supply and return header. The collector is normally oriented and inclined in the North-South direction and tracking of the sun occurs East-West. Various versions of this collector is described; and their uses for sea water desalination, absorption cooling, and power production are discussed. (WHK)

33524 Large scale solar heating and air conditioning in the United States. Eldredge, L.L. (Northrup Inc., Hutchins, TX). pp 30-37 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

The present status of the solar energy market in the US is briefly discussed and the Fresnel lens Northrup Concentrating Solar Collector is described. Several installations that use the Northrup Concentrating Solar Collector are briefly described. (WHK)

33525 Stationary concentrator for industry. McVeigh, J.C. (Brighton Polytechnic, Moulsecoomb, England). pp 38-43 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

A stationary collector with a compound parabolic concentrator which has been developed for UK conditions is described. These collectors have several advantages over the traditional flat plate collector: (a) they are visually attractive; (b) they need comparatively less insulating material as the reflecting surfaces surround the absorber; (c) the area of the absorber surface relative to the collector panel area is small - this enhances the performance under moderate radiation conditions; and (d) the relatively small absorber surface leads to economies in production. The prototype collector was constructed as a panel with overall dimensions of 1980 mm x 1270 mm containing seven parallel troughs approximately 120 mm deep. An efficiency of 30% was achieved at a point where some conventional flat plate collectors would cease to operate.

33526 Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978). 121p. (CONF-7808125—).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Separate abstracts were prepared for the 15 papers presented. (WHK)

33527 First-order design variables for concentrating solar collectors. Kreider, J.F. pp 2-11 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Solar flux is inherently of very high thermodynamic quality (low entropy). However, the terrestrial use of solar heat at high temperature can only be achieved by means of solar concentrators of the reflecting or refracting type. It is the purpose of this paper to describe the three major design variables of concentrators - optical efficiency, heat loss coefficient and heat removal factor. The optical efficiency eta/sub o/ embodies many important concentator properties including mirror surface reflectance and slope, tracking accuracy, receiver transmittance and absorptance and solar beam incidence angle effects. The heat loss coefficient U/sub c/ of a solar concentrator represents its thermal performance and depends upon the relative magnitudes of convection and conduction flux rates, surface emittances of receiver components and operating temperature relative to the environment. The third design parameter - the heat removal factor F/sub R/ - is a measure of the efficiency of the receiver when viewed as a heat exchanger. Its value is governed by working fluid properties and flow rates as well as a heat exchanger. Its value is governed by working fluid properties and flow rates as well as the thermal properties of the receiver material. The principal factors which determine the value of eta/sub o/, U/sub c/ and F/sub R/ are described.

33528 System designs fr low cost-low ratio solar concentrators. Knasel, T.M. (Science Applications, Inc., McLean, VI). pp 14-22 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Recent work in low cost-low ratio concentrating solar collectors is described. To keep cost low, stationary systems are assumed, a concentration of at least two to three is desired. Relatively even energy distribution at the receiver, minimal loss of diffuse radiation and simple low cost surfaces are important additional criteria. A brief discussion of stationary imaging and non-imaging collectors is presented. Examples of non-imaging collectors incorporating booster and trapping designs indicates features of potentially cost effective system designs.

33529 Linear echelon refractor/reflector solar concentrators. Vanderwerf, D.F.; Anderson, R.H.; Appeldorn, R.H. (3M Co., St. Paul, MN). pp 23-28 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Some new configurations for linear incremental or Fresnel refractors and reflectors for solar energy concentration are described. The first system, a reflex type lens, uses crossed linear echelon elements and has convergence power in two dimensions. This refractor/reflector concentrates solar radiation to a spot focus. Large area solar concentrators can be sectionally constructed to provide high power solar flux concentration. The second type of echelon reflector forms a linear focus of incident solar radiation. The reflector is selectively tilted with respect to incoming solar radiation, such that the design eliminates all riser step blockage of radiation at the reflecting echelons. This results in a higher efficiency concentrator than is achievable with a normally oriented linear focus concentrator. Design parameters and a ray trace analysis are presented for both concentrator systems.

33530 Flat plate multiple pass solar collector using aqueous optical properties. Antrim, W.D. Jr.; Pitasi, M.J.; Miller, R.W. (American Science and Engineering, Inc., Cambridge, MA). pp 29-35 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

A flat plate multiple pass solar collector which is believed to be new to the subject and gaps the need between concentrators (which typically are associated with high cost of manufacture and vulnerability to the elements) and the conventional flat plate collectors (which typically reradiate as much energy as received on reaching a temperature level less than suitable for air conditioning is described. This new multiple pass flat plate collector performs optically by taking advantage of two fortuitous characteristics of plain water; one, high transparency in the visible spectrum, and two,

near total opacity in the infrared. As solar energy heats the water, its potential radiative escape is via the infrared. A simple multiple pass system impacts the solar energy sequentially as it is blocked by opacity of the water in the earlier passages. The design is also such that it minimizes air convection losses by virtue of the layers of the multipass system. The function of the design has been confirmed by computer analysis. A model has been built and tests are in progress.

33531 Parabolic solar reflector for accurate and economic producibility. Antrim, W.D. Jr.; Miller, R.W.; Pitasi, M.J. (American Science and Engineering, Inc., Cambridge, MA). Contract EM-78-C-04-4275. pp 36-45 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

The fabrication of reflective parabolic surfaces for solar concentrating collector systems is fraught with the produceability problems of cost and accuracy. In the considerable experience at American Science and Engineering, Inc., and in the wide perusal of the subject literature and pertinent company brochures, producing a reasonably accurate, stable trough type parabolic collector is aptly described by the buzz words labor-intensive. In order to overcome this obstacle to the progress of this type of solar concentrating collectors, a number of iterations at AS and E has led to the design and fabrication of an engineering model that is not only reasonably accurate, but is assembled from a few simple parts in moments. The design is the result of a continuous effort in solar energy at American Science and Engineering, Inc., and the present intention is to use the design towards fulfillment of the AS and E contract which is part of the DOE Solar Collector Research and Development Program. The design, operation, and performance of the concentrating collector are described.

33532 Comparison of solar thermal energy collection using fixed and tracking collectors. Garrison, J.D.; Craig, G.T.; Morgan, C. (San Diego State Univ., CA). pp 46-54 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Solar thermal energy collection at seven sites is calculated for air and vacuum flat plate collectors and a vacuum collector using cylindrical Winston concentration. The hourly intensity and angular distribution of solar radiation is predicted for the calculations using insolation measurements and an insolation model. Tracking configurations include two-axis, vertical axis, polar axis and east-west axis tracking. Fixed collector arrays are all tilted towards the equator at the latitude angle. These calculations indicate energy collection varies linearly with cloudiness index K/sub T/. Diffuse radiation is ~ 15% of energy collected by concentrating collector arrays at low operating temperatures where large acceptance angles maximize energy collection. Smaller acceptance angles, required to maximize collection at higher operating temperatures, eliminate the advantage of Winston concentration for tracking arrays. Absorbers with high selectivity are necessary for high efficiency of fixed evacuated collectors at higher operating temperatures. Ratios of tracking to fixed collector energy collection increase rapidly between ~ 200°C and ~ 300°C making it likely that tracking becomes economically viable in this temperature range. These results are easily extended to other cylindrical concentrating collectors.

33533 Chemical vapor deposited molybdenum films for use in photothermal conversion. Carver, G.E.; Allred, D.D.; Seraphin, B.O. (Univ. of Arizona, Tucson). Contract ER-78-S-02-4899;EY-76-S-04-3709. pp 66-71 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

High infrared reflectance, coupled with high solar absorptance, is required for efficient photothermal conversion. Converters can be fabricated by depositing an absorber on a highly reflecting metal. The absorber functions in the visible, yet becomes transparent in the near infrared, allowing the metal to suppress the thermal emittance. Economic considerations demand the use of thin films, rather than bulk materials. The thin film reflector must be capable of withstanding high temperatures of operation. Compatibility of the reflector with the substrate below, and the absorber above, is required for long-time service. Highly reflective silver films suffer reflectance losses by agglomeration, and require stabilization layers. Refractory materials such as molybdenum avoid agglomeration at temperatures of operation of photothermal converters. Unlike other deposition methods, chemical vapor deposition (CVD) can produce molybdenum films with an infrared reflectance rivaling that of bulk molybdenum. CVD is a non-vacuum based technology with potential for sequential through-put fabrication. Studies are being undertaken to determine how sensitively the reflectance reacts to inclusions of impurities into the molybdenum. Thin film passivators deposited on the molybdenum prevent reflectance losses induced by oxidation, and insure high temperature survival of optimal reflectance. Complete converter stacks have been annealed at 550°C for over 1000 hours in air.

33534 Chemical vapor deposited amorphous silicon for use in photothermal conversion. Booth, D.C.; Janai, M.; Weiser, G.; Allred, D.D.; Seraphin, B.O. (Univ. of Arizona, Tucson). pp 72-75 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Efficient photochemical conversion requires surfaces of high solar absorptance and low thermal emittance. This can be accomplished by the tandem action of a good infrared reflector overlaid by a film of sufficient solar absorptance that is transparent in the infrared. Crystalline silicon is a suitable candidate for the absorber layer. Its indirect band gap, however, results in a shallow absorption edge that extends too far into the visible. In contrast, the absorption edge of amorphous silicon is steeper and located farther into the infrared, resulting in a larger solar absorptance. The fabrication of amorphous silicon absorbers by chemical vapor deposition (CVD) is reported. Their optical and structural properties are determined as the function of the deposition temperature. The effects of a progressive crystallization during anneal above 650°C are described, and the performance of converter stacks that are identical twins except for the use of a polycrystalline silicon absorber in one and an amorphous absorber in the other are reported.

33535 Colored stainless steel: a new type of selective absorber. Karlsson, B. (Univ. of Arizona, Tucson); Ribbing, C.G. pp 76-83 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

Reflectance measurements on stainless steel colored in an acid solution are reported; a-values between 0.62 and 0.91 together with e = 0.1 were obtained. The steel deteriorates at temperatures over 200°C; the deterioration mechanisms are dehydration and oxidation. It is suggested that the colored steel should be stabilized at higher temperatures by coating it with a thin film such as Cr_2O_3, SiO_2, Al_2O_3 or Si_3N_4.

33536 Microstructural characterization of a black chrome solar selective absorber. Lampert, C.M. (Univ. of California, Berkeley). pp 84-90 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

The microstructure and reflective properties of CHROMONYX type of black chrome/metal selective absorber was investigated to obtain a better understanding of their influence upon the mechanism of wavelength selectivity. Hemispherical reflectance measurements were performed on seven samples. In this research, the best selectivity a/e ratio was found by these measurements to be 0.7 micron of black chrome on nickel and 1.0 micron of black chrome on copper. Both scanning and transmission electron microscopy were employed to study micro-structure and chemical composition. As a result of the combined studies, some consequences of black chrome thickness and the metallic substrate were determined. It was determined that black chrome consisted of a very fine metallic distribution of particles of chromium in the 100 A range, suspended within a matrix of a chromium oxide phase. This assembly was, in turn, agglomerated into larger particles within the 0.05 to 0.3 micron size range. These larger particles formed a continuous network which constituted the surface coating.

33537 New instrumentation for high temperature and hemispherical measurements of selective surfaces. Jacobson, M.R.; Lamoreaux, R.D.; Shimshock, R.P.; Raouf, N.; Seraphin, B.O. (Univ. of Arizona, Tucson). Contract ER-78-S-02-4899;EY-75-S-04-3709. pp 92-97 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

The proper evaluation of selective surfaces requires that their optical properties and durability be determined under simulated operating conditions. The Measurement Laboratory at the University of Arizona's Optical Sciences Center has been involved in this area for the last six years. Recent developments include: (1) A transmission cell for the high temperature reflectometer is being designed and built to measure samples at high temperatures - 800°C - under vacuum or controlled atmospheres. Such samples include thin film refractory coatings suitable for concentrating collector receivers and laser mirrors deposited on transparent substrates for transmission

measurements from 0.38 to about 8 μm. (2) A new data processing system has been interfaced with the existing integrating sphere reflectometer. Sample-and-hold electronics process the triple-beamed - sample, reference, and background - signal and pass it to a M6800 based microcomputer. The latter averages the signal until a sufficient signal-to-noise level is reached and advances the dispersive optics to the next wavelength. (3) A cylindrical vacuum emissometer for the measurement of the total hemispherical radiative power loss from a heated sample is under consideration . Coupled with existing, specially designed furnaces for lifetime testing, the Measurement Lab will provide adequate simulation capabilities for testing selective surfaces operating in most standard collector configurations. (4) A Gaertner L119 ellipsometer is being extended into the near infrared to provide measurements of optical constants of absorber materials through the solar spectrum.

33538 **Specularity measurements for solar materials.** Lind, M.A.; Hartman, J.S.; Hampton, H.L. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. pp 98-105 of Optics applied to solar energy IV. Volume 161. Masterson, K.D. (ed.). Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1978).

From 22. annual symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (30 Aug 1978).

A technique using Fourier transform analysis which is suitable for measuring the specularity of solar glass components in the mrad and sub-mrad is discussed and demonstrated. A brief mathematical background as well as illustrative examples are included. A number of methods for image analysis are discussed with particular emphasis given to electronic integrating detectors. Typical Fourier plane image distributions are given for a few common solar utilization materials and details of the instrument used to produce the images are considered. The limitations and capabilities of various instruments are outlined along with methods for further enhancing the utility and sensitivity of the technique.

HEAT STORAGE

REFER ALSO TO CITATION(S) 33447, 33448, 33449, 33450, 33451, 33455, 33456, 33642

33539 (DOE/JPL—1060-12(Vol.1)) **Thermal storage applications workshop. Volume 1. Plenary session analysis.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Feb 1979. Contract EX-76-A-29-1060. 21p. (JPL-PUB—79-8(Vol.1)). NTIS, PC A02/MF A01.

On February 14 and 15, 1978, a workshop on solar power development and thermal and thermochemical energy storage technology was held at Golden, Colorado. These proceedings contain the record of this workshop. They are divided into two volumes. Volume I presents an analysis and condensation of information discussed in round-table plenary sessions.

33540 (DOE/JPL—1060-12(Vol.2)) **Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Feb 1979. Contract EX-76-A-29-1020. 273p. (JPL-PUB—79-8(Vol.2)). NTIS, PC A12/MF A01.

The 12 papers included were entered into the data base separately. (WHK)

33541 (DOE/JPL—1060-12(Vol.2), pp 48-62) **High temperature storage technologies for solar thermal applications.** Gordon, L.H. (Lewis Research Center, Cleveland, OH). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The general objective in the High Temperature Thermal Energy Storage Project is to develop the technology for cost and performance effective thermal energy storage systems for end-use application sectors. The technologies include all sensible and latent heat storage for temperatures above approximately 250°C. The primary applications include not only solar energy systems but also conventional electric power generation, industrial processes, transportation, buildings and communities. The program is outlined. (WHK)

33542 (DOE/JPL—1060-12(Vol.2), pp 199-212) **Systems analyses of storage in specific solar thermal power applications.** Dodd, H.M. (Sandia Labs., Albuquerque, NM). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

Three approaches using optimization techniques plus an additional approach which attempts to discover generalized results concerning the appropriate sizes of solar collector and storage medium for a given load are outlined. The three optimization techniques either have thermal storage built into the model or (in one case) have a general storage module which can be representative of thermal storage.

33543 (DOE/JPL—1060-12(Vol.2), pp 213-247) **Value of seasonal storage of solar energy.** Iannucci, J.J. (Sandia Labs., Livermore, CA). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The objective of this study is to examine the worth of storage to a stand-alone solar electric plant. A stand-alone or grid-independent plant is one which must provide the entire load for an electrically isolated community. This stand-alone plant may be either a pure solar plant or a solar/fossil hybrid. The optimal size and worth of storage for such a specific type of plant is only one measure of the importance of storage to solar electric plants in general. The methodology, preliminary results, and some tentative conclusions are presented not only about seasonal storage, but also about storage in general.

33544 (DOE/JPL—1060-12(Vol.2), pp 267-275) **Need for specific requirements by storage system development teams.** Calogeras, J.E. (Lewis Research Center, Cleveland, OH). 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

The need for a set of guidelines prior to the initiation of a storage technology effort that is aimed at satisfying the requirements of a range of solar power applications is pointed out. It is shown that system studies are needed to: (1) identify specific storage system characteristics, operational requirements and development requirements; (2) evaluate developed concepts for validation, (and decide what constitutes validation); and (3) evolve the best solar/storage integrated system. Examples are given. (WHK)

33545 (LA-UR—80-2429) **Rock bed behavior and reverse thermosiphon effects.** Perry, J.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—5). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Two rock beds, in the Mark Jones and Doug Balcomb houses, have been instrumented, monitored, and analyzed. Observed experimental operation has been compared with, or explained by, theoretical predictions. The latter are based on one-dimensional finite-difference computer calculation of rock bed charging and discharging, with fixed or variable inputs of air flow rate and temperature. Both rock beds exhibit appreciable loss of stored heat caused by lack of backdraft dampers or incomplete closure of such dampers. These topics are discussed, and some improvements that might be made in future installations are noted.

33546 (SERI/RR—731-364) **Preliminary requirements for thermal storage subsystems in solar thermal applications.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1980. Contract AC02-77CH00178. 229p. NTIS, PC A11/MF A01.

Methodologies for the analysis of value and comparing thermal storage concepts are presented. Value is a measure of worth and is determined by the cost of conventional fuel systems. Value data for thermal storage in large solar thermal electric power applications are presented. Thermal storage concepts must be compared when all are performing the same mission. A method for doing that analysis, called the ranking index, is derived. Necessary data to use the methodology are included.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 33712

33547 (NMEI—50) **Feasibility study for establishing a centralized geothermal data base for New Mexico. Final report, June 1, 1979-October 15, 1979.** Klimowicz, G.; Martin, N. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jan 1980. Contract AS07-78ID01756. 56p. (EMD—78-2219). NTIS, PC A03/MF A01.

The purpose of this work is to catalog the information available and to make recommendations toward improving its accessibility. Existing computerized and non-computerized data sources are identified at both the state and national level. The content and accessibility of each such data base are investigated, as well as its suitability for aiding geothermal development. A catalog of such information is provided for each of the following data sources: GEOTHERM, WATSORE, STORIT, RPPM, GRID, HISS, EID air quality, and EID water quality. The available computing facilities within the state are evaluated for their appropriateness as a central storage facility for the many data sources. Recommendations are made for the establishment of a centralized geothermal/environmental data base. Included are recommendations for the computing facilities to be used by such a data base. How to obtain access to a given data base is described. This includes whether the data base is

accessible from within New Mexico, necessary agreements, and contact persons. A glossary of computer-related terms and a brief description of knowledge-based problem-solving are included. (MHR)

RESOURCE STATUS AND ASSESSMENT

33548 (ORESU-W—78-001) **Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977.** (Oregon State Univ., Corvallis (USA). Sea Grant Coll. Program). Sep 1978. 52p. Oregon State Univ., Sea Grant College Program, Corvallis.

Separate abstracts were prepared for one paper and two panel discussions. (MHR)

33549 (ORESU-W—78-001, pp 5-23) **Geothermal energy: overview.** Reistad, G.M. (Oregon State Univ., Corvallis). Sep 1978.

In Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977.

The categories and locations of geothermal resources are reviewed. Electric and non-electric uses of geothermal energy are mentioned. The magnitude of the geothermal resource base and its expected use are described. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

33550 (DOE/AL/10563—T5) **Modification and implementation of the M.E.T.C. SIMPAC program.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). May 1980. Contract AC32-79AL10563. 74p. NTIS, PC A04/MF A01.

The work reported in this study covers the modifications performed by PTTS in the three dimensional unsteady state model developed by the Morgantown Energy Technology Center by W. K. Sawyer and J. C. Mercer, A Diffusivity Model for Fluid Flow and Heat Conduction in Porous Media (Merc/SP-77/2), August 1978, United States Department of Energy, Morgantown Energy Technology Center (M.E.T.C.), Morgantown, West Virginia. The model is used to simulate a liquid dominated geothermal reservoir system. A series of cases is cited showing the versatility of the model as a simulation tool.

USA

33551 (DOE/ET/28392—41) **Summary of potassium/argon age dating, 1979.** Evans, S.H. Jr. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Feb 1980. Contract AC07-78ET28392. 30p. NTIS, PC A03/MF A01.

During FY-79 the K/Ar dating laboratory at the Department of Geology and Geophysics of the University of Utah became operational. During the past calendar year forty-seven dates have been produced from areas predominantly in Utah. Dating has also been done on areas in Nevada and Montana through the State-Coupled program and Case Studies Support program. Areas in wich activity was concentrated include: Cove Creek Domes/Twin Peaks Area, SW Utah. Here volcanic activity spanned the time from 2.74 to 2.35 M.Y., with a mean age of 2.50 +- 0.14 M.Y. Black Rock Desert, SW Utah. Two dates on a single flow indicate an age of 1.49 +- 0.08 M.Y. for a flow previously undated. Wildcat Creek Area, SW Utah. Dating of rhyolite flows from this area gives a mean age of volcanism of 9.25 +- 0.16 M.Y., considerably older than previously inferred by the work of Haugh (1978). Mineral Mountains Pluton, SW Utah. Twelve dates on phases of the pluton indicate a complex history of intrusion, and more work is indicated in order to derive a coherent picture of the magmatic events leading to the formation of this batholith. Blackfoot Reservoir, Idaho. Two dates on rhyolite domes, previously updated, give ages of 1.56 +- 0.06 M.Y. and 1.28 +- 0.15 M.Y.

33552 (DOE/ET/28392—44) **Model study of the regional hydrogeologic regime, Roosevelt Hot Springs, Utah.** Smith, L. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). May 1980. Contract AC07-78ET28392. 36p. NTIS, PC A03/MF A01.

A regional hydrogeologic model is used to investigate the potential for water recharging in the Tushar Mountains to move at depth beneath the Mineral Mountains to discharge in Milford Valley. Simulations carried out over a range of water table positions and assumed depths to a lower impermeable boundary suggest it is unlikely that the topographic configuration alone could drive such a flow system. Specific geologic conditions are necessary if interbasin flow is to occur. However, simulations based on a simplified hydrologic model of the regional geology suggest this is not the case. A regional hydraulic anisotropy greater than 10:1 (Kx/Kz) leads to interflow if the granitic Mineral Mountain pluton and the volcanics in the Tushar Mountains have similar hydraulic conductivities. If either of these units is more nearly isotropic or if the granitic rocks have a greater vertical than horizontal hydraulic conductivity, no interbasin flow is observed. On the basis of available geologic evidence, this latter case seems to be the most likely.

33553 (DOE/ID/12079—4) **Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah.** Crecraft, H.R.; Nash, W.P.; Evans, S.H. Jr. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). May 1980. Contract AC07-79ID12079. 211p. NTIS, PC A10/MF A01.

Two distinct sequences of silicic volcanism at the Twin Peaks volcanic field, Millard County, Utah, spanned periods from 2.74 +- .10 to 2.54 +- .09 m.y. and 2.43 +- .08 to 2.35 +- .08 m.y., and produced a total exposed volume of 4 km^3 of rhyolites and volcanoclastics. Wet chemical, x-ray fluorescence, microprobe, atomic absorption, and neutron activation methods have been employed to obtain a wide range of chemical data on whole rock and mineral separate samples. Calculated distribution coefficients are comparable to previously published values for high silica rocks. Each sequence is characterized by a systematic trend from $< 72\%$ to $> 76\%$ SiO_2. Accompanying this increase in SiO_2 over time are increases in Rb, Y, Sb, Cs, U, Th, HREE and decreases in Mg, Co, Fe, Sr, Ba, and LREE. Decreases in temperature and fO_2 and an increase in fH_2O are also indicated. These trends are very similar to gradients observed in ash flow tuffs erupted instantaneously from compositionally zoned magma chambers. Chemical evolution at Twin Peaks was dominated by the same mechanism of liquid state differentiation which produce the compositional zonation in larger silicic magma chambers.

NON-USA

REFER ALSO TO CITATION(S) 33556

33554 (LBL—10540) **Subsurface geological and geophysical study of the Cerro Prieto geothermal field.** Lyons, D.J.; van de Kamp, P.C. (GeoResources Associates, Napa, CA (USA)). May 1980. Contract W-7405-ENG-48. 17p. (CONF-7910166—14). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

This subsurface investigation of the Cerro Prieto field and surrounding area was undertaken to provide information on its stratigraphy, structure, hydrothermal alteration, and reservoir properties for use in designing reservoir simulation models and planning development of the field. Another objective was to gain insight into the depositional, tectonic, and thermal history of the Cerro Prieto area. The following types of data were used in this study: (1) well sample descriptions and analyses (x-ray diffraction, petrography, and porosity-permeability); (2) well logs (spontaneous potential, resistivity, gamma-ray, density, sonic and caliper; (3) geophysical surveys (resistivity, gravity, magnetics, refraction seismic, reflection seismic, and seismicity); (4) physiography (modern depositional patterns and surface manifestations of faults); and (5) regional geology. The detailed interpretation of the subsurface geology presented should be useful for field development. (MHR)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

33555 (DOE/ET/28392—42) **Geothermal exploration program, Hill Air Force Base, Davis and Weber Counties, Utah.** Glenn, W.E.; Chapman, D.S.; Foley, D.; Capuano, R.M.; Cole, D.; Sibbett, B.; Ward, S.H. (Utah Univ., Salt Lake City (USA). Earth Science Lab.; Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Mar 1980. Contract AC07-78ET28392. 89p. (ESL—34). NTIS, PC A05/MF A01.

Results obtained from a program designed to locate a low- or moderate-temperature geothermal resource that might exist beneath Hill Air Force Base (AFB), Ogden, Utah are discussed. A phased exploration program was conducted at Hill AFB. Published geological, geochemical, and geophysical reports on the area were examined, regional exploration was conducted, and two thermal gradient holes were drilled. This program demonstrated that thermal waters are not present in the shallow subsurface at this site. (MHR)

33556 (NP—24999) **Tongonan geothermal field Leyte, Philippines. Report on exploration and development.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). Sep 1979. 32p. NTIS, PC A03/MF A01.

Geothermal exploration and development in the Philippines are reviewed. The geology, geophysics, and geochemistry of the Tongonan geothermal field are described. The well drilling, power development, and plans for a 112 MW power plant are included. (MHR)

33557 (JPRS—75887) **China report: science and technology, No. 40.** 16 Jun 1980. Translation of various papers. 66p. NTIS.

Three articles from this report are abstracted for inclusion in the Energy Data Base. The present state and future prospects of geothermal exploration in China are reviewed. An investigation of the genesis of petroleum in the Huanghua Depression is presented. A plan for the classification of oil field waters is described. Separate abstracts are prepared for individual items. (DC)

33558 (JPRS—75887, pp 4-9) **Present state, future prospects of geothermal exploration reviewed.** Siyu, W.; Wei, D.; Jiyang, W.; Mingtao, Z. 16 Jun 1980. Translated from Diqiu Wuli Xuebao; 22: No. 4, 383-385(Oct 1979). NTIS.

In China report: science and technology, No. 40.

The distribution of geothermal activities in China is discussed in relation to tectonic structures. Prospecting for geothermal sources and their utilization and the present state of theoretical, observational, and experimental work in geothermic studies are reviewed. Finally, the future tasks and the prospects of geothermic research in this country are mentioned.

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 34230

33559 (DOE/ET/28392—43) **Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems.** Ballantyne, J.M. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Jun 1980. Contract AC07-78ET28392. 101p. NTIS, PC A06/MF A01.

Chemical compositions of chlorite and sericite from one production well in the Roosevelt geothermal system have been determined by electron probe methods and compared with compositions of chlorite and sericite from porphyry copper deposits. Modern system sericite and chlorite occur over a depth interval of 2 km and a temperature interval of 250°C.

33560 (DOE/ET/28392—46) **Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah.** Rohrs D.T.; Bowman, J.R. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). May 1980. Contract AC07-78ET28392. 88p. NTIS, PC A05/MF A01.

The isotopic composition of hydrogen, oxygen, and carbon has been determined for regional cold springs, thermal fluids, and rocks and minerals from the Roosevelt Hot Springs thermal area. The geothermal system has developed within plutonic granitic rocks and amphibolite facies gneiss, relying upon fracture-controlled permeability for the migration of the thermal fluids. Probably originating as meteoric waters in the upper elevations of the Mineral Mountains, the thermal waters sampled in the production wells display an oxygen isotopic shift of at least +1.2. Depletions of $\delta\ ^{18}O$ in wole rock, K-feldspar, and biotite have a positive correlation with alteration intensity. W/R mass ratios, calculated from the isotopic shifts of rock and water, range up to 3.0 in a producing horizon of one well, although the K-feldspar has experienced only 30% exchange with the thermal waters. While veinlet quartz has equilibrated with the thermal waters, the ^{18}O values of K-mica clay, an alteration product of plagioclase, mimic the isotopic composition of K-feldspar and whole rock. This suggests that locally small W/R ratios enable plagioclase to influence its alteration products by isotopic exchange.

33561 (DOE/ID/12079—3) **Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide).** Withrow, C. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jul 1980. Contract AC07-79ID12079. 21p. (ESL—35). NTIS, PC A02/MF A01.

PLANMAP is a program package that is used to plot geochemical data in plan. The program has no map projection capabilities and is used to plot relatively small work areas that can use a flat-earth approximation. Data are entered by keyboard input and can be listed, edited, and plotted. The plotting functions are performed by using a plotting library similar to a Calcomp subroutine library. This report is a user's guide to the two main programs that comprise PLANMAP.

33562 (DOE/ID/12079—6) **Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide).** Withrow, C. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jul 1980. Contract AC07-79ID12079. 55p. (ESL—36). NTIS, PC A04/MF A01.

SECTION is a program package that provides plots of core sample geochemical data for any or all drill holes in a given area projected onto any predetermined section line. Plot size is user-defined by keyboard input. Holes are plotted in cross section as straight lines defined by collar coordinates, bearing angle, dip angle and length. The program is applicable to small problem areas with relatively short drill holes that are approximately straight. The program is implemented on the University of Utah UNIVAC 1108 computer system. The plotting functions are accomplished by using a plotting library that is similar to a Calcomp subroutine library.

EXPLORATORY DRILLING AND WELL LOGGING

33563 (DOE/ID/12079—1) **Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1).** Atwood, J.W.; Killpack, T.J.; Glenn, W.E. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Mar 1980. Contract AC07-79ID12079. 75p. (ESL—31). NTIS, PC A04/MF A01.

WELLOG is a system of programs developed at the Earth Science Laboratory to be used to digitize well logs and perform some analysis and plotting of the data. Multiple logs can be plotted side by side for correlation analysis and up to three logs can be plotted in a cross plot. Data entry and editing functions are also provided by the programs. This system of well log interpretation programs is presently operating on the University of Utah UNIVAC 1108 computer. Digitizing of well logs is accomplished by an old model CALMA (off-line) digitizer. Those parts of WELLOG that handle the digitized data tapes are extremely machine dependent. The parts of WELLOG that produce the plots and handle the data beyond the digitized data tape are more portable.

33564 (PNL—3377) **Development of the high-temperature redox electrode. Interim report ending March 1980.** Danielson, M.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01.

The oxidation-reduction (known as redox) electrode was studied in a pH range corresponding to that found in a CO_2-silicate buffered system at temperatures ranging from 100 to 250°C. Oxidizing conditions were created by injecting oxygen; the greatest reducing conditions, by using hydrogen. The sulfur system (H_2S, HS^-, S^2) was not examined at this time, but future work will include this system since it is an important component of the geothermal brine. Both a platinized platinum (Pt-Pt) and a bare platinum (Pt-foil) electrode respond to the redox environment. The response does not appear to indicate thermodynamic equilibrium with the chemical environment; instead a mixed potential response is indicated. The difference in potential between a strong oxidizing environment (0.4-ppM O_2) and a strong reducing environment (0.5-atm H_2) is typically > 1 volt at all temperatures. The magnitude of this response makes the platinum electrode a suitable sensor for continuous monitoring of the geothermal environment for oxygen intrusions. The platinized platinum redox electrode is superior to the bare platinum electrode.

33565 (SAND—80-0444C) **High temperature hybrids for use up to 275°C - drift and lifetime.** Veneruso, A.F.; Palmer, D.W.; Reagan, M.G. (Sandia National Labs., Albuquerque, NM (USA); Teledyne Pnilbrick, Dedham, MA (USA)). 1980. Contract AC04-76DP00789. 6p. (CONF-801024—1). NTIS, PC A02/MF A01.

From ISHM annual meeting; New York, NY, USA (20 Oct 1980).

Portions of document are illegible.

The drift and lifetime performance of 275°C hybrid microcircuits that were recently developed are reviewed. This hybrid technology is based on temperature tolerant thick films and discrete silicon JFETs. The results of high temperature circuit testing are reviewed; component and circuit degradation and failure modes are described and compared to predictions; and finally, design rules are given to maximize lifetimes and to minimize performance drift for up to 10,000 hours of operation at 275°C. Although these circuits were developed for instrumenting geothermal boreholes, many other applications for this technology exist in such areas as fossil fuel exploration and production systems, jet engine monitors, and nuclear reactor monitors.

LEGAL AND INSTITUTIONAL ASPECTS

33566 (DOE/ID/12018—2) **Regulation of geothermal energy development in Colorado.** Coe, B.A.; Forman, N.A. (Colorado Geological Survey, Denver (USA)). 1980. Contract FC07-79ID12018. 46p. NTIS, PC A03/MF A01.

The regulatory system is presented in a format to help guide geothermal energy development. State, local, and federal agencies, legislation, and regulations are presented. Information sources are listed. (MHR)

33567 **Drilling for geothermal resources: rules and regulations and minimum well construction standards.** Boise, ID; Dept. of Water Resources (1978). 22p. (NP—25060).

The following geothermal rules and regulations are presented: authority; policy; definitions; drilling; records; blow out prevention; injection wells; abandonment; maintenance; hearings; notice procedures; hearings on refused, limited, or conditioned permit; appeals; penalties; and forms;

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 33578

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 33570

GEOTHERMAL POWER PLANTS

33568 (DOE/RA/28320—1) **Geothermal energy as a source of electricity. A worldwide survey of the design and operation of geothermal power plants.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth (USA); Brown Univ., Providence, RI (USA)). Jan 1980. Contract AS02-76ET28320. 377p. NTIS, PC A17/MF A01.

An overview of geothermal power generation is presented. A survey of geothermal power plants is given for the following countries: China, El Salvador, Iceland, Italy, Japan, Mexico, New Zealand, Philippines, Turkey, USSR, and USA. A survey of countries planning geothermal power plants is included. (MHR)

DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 33556

33569 (LBL—11107) **Test results from the 500 kW direct contact pilot plant at East Mesa.** Nichols, K.E.; Olander, R.G.; Lobach, J.L. (Barber-Nichols Engineering Co., Arvada, CO (USA)). Sep 1980. Contract W-7405-ENG-48. 7p. (CONF-800920—26). NTIS, PC A02/MF A01.

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A 500 kW power plant utilizing direct contact heat exchange (DCHX) between the geothermal brine and the isobutane (IC_4) working fluid is being operated at the East Mesa test facility. The power plant incorporates a 40-inch-diameter direct-contactor approximately 35 feet tall. The purpose of the pilot plant is to determine the feasibility of large-scale direct-contact heat exchange and power plant operation with the DCHX. The binary cycle offers higher conversion factors (heat energy transformed to electrical energy) than the flashed steam approach for geothermal brines in the 300 to 400°F range and preliminary results indicate the DCHX system may have higher performance than the conventional tube-and-shell binary approach. This performance advantage results from the absence of any fouling and the very close pinch temperatures achieved in the DCHX itself. The baseline performance tests for the plant were completed in January 1980. The results of these tests and follow-on testing are covered.

POWER PLANT SYSTEMS AND COMPONENTS

33570 (EGG-FM—5170) **Removal of silica from Raft River geothermal water.** Suciu, D.F.; Miller, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1980. Contract AC07-76ID01570. 64p. NTIS, PC A04/MF A01.

Lack of sufficient quantities of clean surface or near-surface water at Raft River for cooling purposes dictates that cooled geothermal fluid, effluent from the Raft River 5 MW(e) Pilot Power Plant, must also be used as condenser coolant. Prior testing revealed that a water-treatment system would be required to reduce silica and calcium concentrations of the cooling fluid. The water-treatment system specified was to use dolomitic lime for both pH adjustment and source of magnesium. The dolomitic lime treatment was investigated and found to be inadequate. Subsequent testing was done to find chemical systems that would adequately reduce silica concentrations. Three magnesium and two iron compounds were found which reduced silica to acceptable concentration levels. They are magnesium bicarbonate, magnesium chloride, magnesium sulfate, iron sulfate, and iron chloride. Magnesium oxide, using a two-stage countercurrent process, will also reduce silica to adequate levels.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 33567, 33574

33571 (SAND—80-1585) **User/programmer guide for UCMD100 set point manipulation from magnetic tape coordinate data.** Pruskowski, J.J. (Sandia Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 9p. NTIS, PC A02/MF A01.

This document describes program UCMD100 - an Applicon AGS/880 user command used to place drill bits on a geothermal drill bit head.

33572 (SAND—80-7101) **Seal/lubricant systems for geothermal drilling equipment.** Hendrickson, R.R.; Winzenried, R.W. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1980. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01.

The development and testing of seals and lubricants for journal-type roller-cone rock bits for drilling into geothermal reservoirs at temperatures over 260°C (500°F) are described. The conditions experienced by seals and lubricants subjected to geothermal drilling are reviewed along with the basic design requirements for roller-cone bit seals and journal bearing lubricants. Two unique test facilities are described: a seal test machine which simulates pressures, temperatures, and mechanical eccentricities, and a lubricant tester capable of evaluating load-bearing ability at temperature and pressure. Three candidate elastomeric compounds demonstrated 288°C (550°F) capability and several others demonstrated 260°C (500°F) or greater capability. Successful elastomeric seal candidates were proprietary compounds based on EPDM, Kalrez, and/or Viton polymers. Three mechanical seals for reservoir temperatures over 288°C (550°F) are presented. Lubricant screening tests on more than 50 products are summarized, and several newly developed lubricants which meet both the compatibility and lubrication requirements are described. Several seal/lubricant systems are recommended for laboratory or field geothermal drilling tests in roller-cone drill bits. The future availability of drill bits for geothermal use is discussed, as well as the potential spinoffs of the program findings for nongeothermal roller-cone bits.

33573 (SAND—80-7102) **Laboratory and field testing of improved geothermal rock bits.** Hendrickson, R.R.; Jones, A.H.; Winzenried, R.W.; Maish, A.B. (Terra Tek, Inc., Salt Lake City, UT (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

The development and testing of 222 mm (8-3/4 inch) unsealed, insert type, medium hard formation, high-temperature bits are described. The new bits were fabricated by substituting improved materials in critical bit components. These materials were selected on bases of their high temperature properties, machinability, and heat treatment response. Program objectives required that both machining and heat treating could be accomplished with existing rock bit production equipment. Two types of experimental bits were subjected to laboratory air drilling tests at 250°C (482°F) in cast iron. These tests indicated field testing could be conducted without danger to the hole, and that bearing wear would be substantially reduced. Six additional experimental bits, and eight conventional bits were then subjected to air drilling a 240°C (464°F) in Francisan Graywacke at The Geysers, CA. The materials selected improved roller wear by 200%, friction-pin wear by 150%, and lug wear by 150%. Geysers drilling performances compared directly to conventional bits indicate that in-gage drilling life was increased by 70%. All bits at The Geysers are subjected to reaming out-of-gage hole prior to drilling. Under these conditions the experimental bits showed a 30% increase in usable hole over the conventional bits. These tests demonstrated a potential well cost reduction of 4 to 8%. Savings of 12% are considered possible with drilling procedures optimized for the experimental bits.

FLUID TRANSMISSION

REFER ALSO TO CITATION(S) 33581

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

33574 (BNL—50973, pp 68-95) **Process Sciences Division.** Steinberg, M. Dec 1978.

In Annual highlights of programs in energy sciences.

Progress is reported on the following research programs: alternate materials of construction for geothermal applications; cementing of geothermal wells; implementation of concrete-polymer research on repair of deteriorated concrete; improvement of the wear-resistance properties of aggregates by materials impregnation; development of a glass-polymer composite sewer pipe from waste glass; flash hydropyrolysis of coal; alternative process schemes for coal conversion; regenerative process for desulfurization of high temperature combustion and fuel gases; conservation in the ethylene polymers industry-polyketones and polysulfones; and environmental control technologies (1) FHP of coal and (2) atmospheric CO_2 control. (MHR)

33575 (UCRL—84489) **Localized corrosion of steels in geothermal steam/brine mixtures.** McCright, R.D.; Frey, W.F.; Tardiff, G.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 May 1980. Contract W-7405-ENG-48. 6p. (CONF-800920—20). NTIS, PC A02/MF A01.

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Coupons of eight different carbon and chrome-moly alloy steels were exposed to high temperature, high salinity wellhead brine flow at a geothermal well in the Salton Sea Geothermal Field for periods of up to six months. The corrosion rate and corrosion attack morphology of each coupon was determined. Exposure time was a test variable and ranged from one month to six months. Test results indicate that carbon steels generally suffer high corrosion rates and are susceptible to severe localized attack which shows a mesa-canyon pattern. Chrome-moly alloy steels corrode at much lower rates and show an attack pattern of small shallow pits. With time, these pits grow mostly in the lateral direction. These results suggest that chrome-moly alloy steels offer significant improvement over carbon steels and that the disk-shaped pits are not likely to lead to rapid perforation.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 33550

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

33576 (DOE/AL/10563—T4) **Interactive fracture design model.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). May 1980. Contract AC32-79AL10563. 90p. NTIS, PC A05/MF A01.

A computer program is described that can be used to design a fracture stimulation treatment for a geothermal reservoir. The program uses state-of-the-art methods to calculate the temperature of the fracture fluid as a function of time and distance in the fracture. This information is used to determine the temperature dependent properties of the fracture fluid. These fluid properties are utilized to calculate the fracture geometry as a function of time. The fracture geometry and temperature distribution of the fracture fluid are coupled so the subroutines that calculate these distributions have been made interactive.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 33548

33577 (CONF-801014—1) **Moderate temperature geothermal: a direct source of process energy.** Stiger, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 13p. NTIS, PC A02/MF A01.

From Instrument Society of America conference; Houston, TX, USA (20 Oct 1980).

The Raft River Hydrothermal Area, the resource located at the site, and selected experiments conducted at the site are described. The results are summarized. Feasibility studies on the following are reviewed: aquaculture, food drying, essential oil production, and small-scale alcohol demonstration.

33578 (DOE/ET/27228—T1) **Direct application of east coast geothermal resources in a frozen food plant. Final report.** Ammerlaan, A.C.F.; Knebel, M.E.; Czarnecki, R.J. (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Campbell Soup Co., Camden, NJ (USA)). 1979. Contract AC05-79ET27228. 303p. NTIS, PC A14/MF A01.

Portions of document are illegible.

The technical and economic viability of retrofitting an existing frozen food plant in Salisbury, Maryland to utilize the anticipated geothermal resources in that area was evaluated, via a budgetary level design and cost estimating analysis. Based on predicted reservoir data, a design concept was developed from production well through the plant to final brine disposal. A parametric analysis of capital and operating costs was performed which covered the range of geothermal design data developed. Relevant social, financial, environmental, legal, and regulatory institutional relationships were examined and ways to eliminate any barriers they presented against the proposed application were explored. Based on results from the other tasks, the existing DOE East Coast Geothermal Development Plan was evaluated and possible alterations were proposed. (MHR)

33579 (ORESU-W—78-001, pp 33-40) **Biology and husbandry of organisms in geothermal aquaculture: panel discussion.** Sep 1978.

In Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977.

The following topics are discussed: benefits of geothermal resources, research needs, and related uses of geothermal resources. Biology and husbandry are reviewed for the following: shrimp, trout and salmon, catfish, gourami, and other species. (MHR)

33580 (ORESU-W—78-001, pp 41-47) **Production and distribution of organisms in geothermal aquaculture: panel discussion.** Sep 1978.

In Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977.

The following aspects of geothermal aquaculture are discussed: engineering, economics and marketing, and institution and cultural framework. (MHR)

33581 (DOE/ET/28434—T1) **User manual for geothermal energy assisted dairy complex computer programs: PREBLD, MODEL0, MODEL1, MODEL2, FRMAT2, PREPI2, NET2, DAIRY and DAIRY1.** (California State Univ., Chico (USA)). [nd]. Contract AC03-76ET28434. 254p. NTIS, PC A12/MF A01.

The operation of the programs on a computer is described. The programs are divided into two parts: the simulation of the buildings and the simulation of the pipe network. (MHR)

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 33553

ISOTOPE AND TRACE ELEMENT STUDIES

REFER ALSO TO CITATION(S) 33560

WIND ENERGY

WIND ENERGY

REFER ALSO TO CITATION(S) 33376, 33379, 33380

AVAILABILITY (CLIMATOLOGY)

33582 **Wind Energy Task Force. Final report.** Salem, OR; Oregon Department of Energy (1980). 153p. (NP—25026).

Recent estimates made by Battelle Pacific Northwest Laboratories indicate that about 4.7% or 4500 square miles of Oregon has sufficient wind energy density for the siting of wind turbine generators (WTGs). If three 3 megawatt (MW) WTGs were sited in each square mile, the total gross installed nameplate capacity would be about 40,500 MW. This draft presents the work of the Wind Energy Task Force in its investigation of wind energy in Oregon. While the gross potential above is substantial, numerous constraints - ranging from the cost and potential availability of commercial hardware to siting and zoning issues - were examined by the Task Force. The resulting net potential for wind energy systems/nameplace capacity by the year 2000 is approximately 1400 MW.

ECONOMICS

REFER ALSO TO CITATION(S) 33582, 33586

33583 (AD-A—076614) **A feasibility study of windpower for the New England area. Final technical report, 4 June-31 October 1979.** Martin, P.; Balma, M.; Crooks, G.; Endlich, R.; Maxwell, C. (SRI International, Menlo Park, CA (USA)). Oct 1979. Contract N00014-79-C-0539. 244p. NTIS, PC A11/MF A01.

SRI International examined the applicability of large-scale windpower electricity generating systems (WEGS) as an alternative source of energy for the New England States in general and for the U.S. Navy Portsmouth Shipyard at Kittery, Maine, in particular. The Boeing Mod 2 wind machine was selected as representative of current technology in the appropriate size range of 2.5 megawatts (MW) rated capacity. Parametric economic analyses led to the conclusion that WEGS electricity can be at economic parity with the incremental electricity from conventional generators using oil or gas without any allowance for a capacity credit, provided that the annual utilization factor for the WEGS is at least 50%. Such utilization appears to be achievable at elevations between 620 and 1,240 m (2,000 and 3,000 ft). About one-eighth of the 35,500 sq kilometers of air space reviewed in New Hampshire is at such elevations. Nonutility financing and capitalization can halve the costs of WEGS electricity. Nonutility ownership of WEGS is encouraged by recent state and federal legislation. The primary potential WEGS environmental impact, interference with television reception, can be mitigated by installation of cable TV services.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33680

WIND ENERGY ENGINEERING

APPLICATIONS

REFER ALSO TO CITATION(S) 33350, 33351, 33353

TURBINE DESIGN AND OPERATION

33584 (PNL—3426) **Turbulence spectrum observed by a fast-rotating wind-turbine blade.** Connell, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 35p. NTIS, PC A03/MF A01.

The spectrum of turbulence encountered by a point on a fast-rotating wind turbine blade is shown to be possibly quite different from that measured by a stationary anemometer. The physically reasonable expectations are supported quantitatively by experiments using Pacific Northwest Laboratory's vertical-plane anemometer array. The measurements indicate that the blade encounters energy densities in two regions of the turbulence spectrum much different than those seen by stationary anemometers. For typical turbine types and wind conditions, the spectral energy redistribution phenomenon may be significant only for turbine blade diameters larger than 10 m. The spectral shift should also affect gust statistics for rotting blades; the duration of gusts that are smaller than the diameter of the disk of blade rotation will decrease. Correspondingly, the rise rate will increase by a factor of about ten.

33585 (SAND—80-0085) **VAWTDYN: a numerical package for the dynamic analysis of vertical axis wind turbines.** Lobitz, D.W.; Sullivan, W.N. (Sandia Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01.

In order to design wind turbines which possess long life and at the same time use a minimum quantity of low-cost materials, it is essential that dynamic, in addition to static, structural analyses be performed to eliminate unnecessary margins of safety resulting from undetermined dynamic amplifications. The VAWTDYN package provides a tool for assessing these amplifications in two-bladed vertical axis wind turbines. The dynamic model on which the package is based contains turbine motions most commonly observed in existing research systems. Gyroscopic effects, structural damping, aerodynamic wind loading, and power generation through either an induction or synchronous generator are also included in the model. In addition to a comprehensive description of the model, this report documents the efforts that have gone into the verification, qualification, and demonstration of the package.

SITE CHARACTERISTICS

33586 (AD-A—076975) **Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report.** Vachon, W.A.; Downey, W.T.; March, F.; Madio, F.R.; Schimke, G.R. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Oct 1979. Contract N00014-79-C-0536. 189p. NTIS, PC A09/MF A01.

A feasibility study was conducted to determine whether the wind energy in the mountainous regions of New Hampshire could be used as a possible energy course for the Portsmouth Naval Shipyard in Portsmouth, New Hampshire. The results indicate that there is adequate wind energy available at mountain sites to drive even the largest wind turbine generators (WT's) now planned, and that many potential sites exist in relatively close proximity to utility lines. Eight specific sites were identified on the basis of available wind speed data, the incidence of severe icing, environmental constraints, plus on-site interpretation of vegetative deformation by the wind (tree flagging). Based on the experiences of this study there appears to be a limited number of available WT sites which have sufficient geographic extent to support large clusters (i.e., farms) of WT's of approximately 20-100 MW rating. Technically, the local utility can 'wheel' power to the Naval Shipyard from mountain sites, but doing so would not be cost-effective for the Shipyard because of an abundance of on-site, low-cost cogenerated electricity. A simple near-term approach to wind power development in New Hampshire appears to be through the private exploitation of WT clusters of less than 5 MW capacity on private land.

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 33599, 33731, 33732, 33733, 33734

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 33596

33587 (EPRI-CS—1418) **Influence of coal mineral matter on slagging of utility boilers. Final report.** Hazard, H.R. (Battelle Columbus Labs., OH (USA)). Jun 1980. 178p. NTIS, PC A09/MF A01.

In an experimental project to explore the role of coal minerals in boiler slagging and fouling, five tangentially fired boilers having different slagging experiences and fired with different coals were studied. Temperatures and compositions of furnace gas were measured, samples of pulverized coal, furnace ash, and fly ash were collected and analyzed, boiler ash deposits were observed, and operating data were recorded. Marked differences were found in compositions and fusion properties of ash from different coal density fractions. For two slagging coals, 35 and 50 percent respectively, of the total ash was found in the coal fractions heavier than 1.6 sp. gr, and the viscosity of ash in these fractions at 2300°F was extremely low. Ash in lighter coal fractions was of high viscosity and should not cause slagging problems. The dense fractions of three non-slagging coals had no comparable low-viscosity ash. In parallel studies of furnace deposit structure, it was found that glassy spherical particles forming much of the deposit were similar in composition to ash found in individual coal particles, so that they could be formed without interaction between particles.

33588 (P—300-80-021) **Municipal waste water as a source of cooling water for California electric power plants.** McDonald, T. (California Energy Commission, Sacramento (USA)). May 1980. 60p. California Energy Commission, Sacramento.

The results of an investigation of sources of municipal waste water for potential use as cooling water in California power plants and the major factors which affect this practice are presented. Municipal treatment facilities in California with discharge volumes deemed adequate to supply new power plants are identified. Also included is a summary of the experiences of several utilities in California and other western states with existing or planned applications of municipal waste water in power plant cooling towers. Due to limited supplies of high-quality water, municipal waste water is increasingly viewed as an alternative source of supply for a variety of water uses, including electric power plant evaporative cooling. In California, enough municipal effluent is discharged to the ocean to conceivably supply the total projected cooling water needs of new power plants for the next 20 years or more. A number of existing applications of such waste water for power plant cooling, including several California cases, demonstrate the technical feasibility of its use for this purpose. However, a combination of economic, environmental, and geographic factors reduce the likelihood of widespread use of this alternative for meeting anticipated large increases in power plant water requirements in the state. The most important factors are: the long distances involved; the public health concerns; added costs and environmental effects; and unreliability of supply quality.

33589 (PNL-SA—7422) **Drift deposition from mechanical draft cooling towers.** Laulainen, N.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1979. Contract AC06-76RL01830. 11p. (CONF-790445—11). NTIS, PC A02/MF A01.

From Annual meeting of the institute of environmental sciences; Seattle, WA, USA (29 Apr 1979).

A comprehensive experiment to study drift from mechanical draft cooling towers was conducted during June 1978 at the PG and E Pittsburg Power Plant. The data from this study are to be used for drift deposition model validation. Results show the effects of tower geometry and orientation with respect to the wind and to single or two tower operation. The effect of relative humidity on droplet evaporation as a function of downwind distance can also be seen.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 33758

COMPONENTS

33590 (EPRI-CS—1444(Vol.2)) **Air/gas system dynamics of fossil fuel power plants. Volume 2. Mathematical system analysis. Final report.** Goldschmied, F.R.; Wormley, D.N.; Rowell, D. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jul 1980. 105p. NTIS, PC A06/MF A01.

Combustion air/flue gas system dynamic problems in fossil fuel power plants are discussed. These problems are characterized in terms of significant pressure and flow dynamic variations which have led to equipment and ductwork vibrations in a number of plants and have eventually resulted in ductwork and/or equipment failure. A computer-based mathematical model was developed for the study

of air/gas system dynamic problems. The model is useful for studies of basic system stability and surging as well as the response of the system to changes in damper settings and to disturbances generated by fans and other equipment. The analysis is based upon pressure/flow wave transmission in ducts and includes the effects of nonlinear fan, damper and equipment characteristics; it can be used for identifying frequencies for which significant disturbance amplification may occur. The analysis has been implemented in a modular computer program which is capable of running on a minicomputer. The program may be modified to represent specific plant configurations by altering three subroutines. The analysis has been applied to two balanced-draft oil-burning power plants, a 500 mW unit and a 125 mW unit. Data generated with the analysis to simulate a damper ramping transient have agreed closely with experimental data. Data generated by injecting white flow noise at selected fans in the two plant simulations have been processed to identify frequencies where significant amplifications occurs in plant sections. These data compared reasonably well with experimental data measured at the two plants.

33591 (EPRI-EL—1424(Vol.3)) **Determination of synchronous machine stability study constants. Final report.** de Mello, F.P.; Hannett, L.N. (Power Technologies, Inc., Schenectady, NY (USA)). Jun 1980. 385p. NTIS, PC A17/MF A01.

The study documented in this final report deals with investigations of test methods for derivation of model parameters and validation of synchronous-machine model structures for use in stability studies. The period of performance was April 1977 to December 1979. Tests and analysis were performed on Potomac Electric Company's Chalk Point Unit No. 3, a General Electric 732,300-kVA, 3600-rpm generator, and on Ontario Hydro's Nanticoke Unit No. 8 a Parsons 588,000-kVA, 3600-rpm unit. The basic conclusions of this work are: (1) load-rejection tests are practical and provide good data for derivation of machine model parameters and for verification of adequacy of model structures; (2) state-of-the-art, second-order model structures for both the d- and q-axis are adequate for the representation of machine flux dynamics in response to stator currents and modifications of the d-axid model are needed to properly represent field-current transients that are affected by rotor iron effects; and (3) improvements in saturation representation seem to offer the greatest potential for gains in machine model accuracy.

ECONOMICS

33592 (PNL—3458) **Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants.** Nieves, L.A.; Patton, W.P.; Harrer, B.J.; Emery, J.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 110p. NTIS, PC A06/MF A01.

This report presents estimates of the costs of new coal and nuclear base-load generating capacity which is either currently under construction or planned by utilities to meet their load-growth expectations during the period from 1980 to 1995. These capacity cost estimates are used in conjunction with announced plant capacities and commercial-operation dates to develop state-level estimates of busbar costs of electricity. From these projected busbar costs, aggregated estimates of electricity costs at the retail level are developed for DOE Regions. The introductory chapter explains the rationale for using the cost of electricity from base-load plants to approximate the marginal cost of electricity. The next major section of the report outlines the methodology and major assumptions used. This is followed by a detailed description of the empirical analysis, including the equations used for each of the cost components. The fourth section presents the resultant marginal cost estimates.

OFF-PEAK ENERGY STORAGE

33593 (ANL—80-20) **Conceptual designs for utility load-leveling battery with Li/FeS cells.** Zivi, S.M.; Kacinskas, H.; Pollack, I.; Chilenskas, A.A.; Grieve, W.; McFarland, B.L.; Sudar, S. (Argonne National Lab., IL (USA); Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jul 1980. Contract W-31-109-ENG-38. 96p. NTIS, PC A05/MF A01.

In 1978, a conceptual design of a 100 MW-h load-leveling battery system having Li alloy/FeS cells was developed as a result of a joint effort between ANL and Rockwell International. In this conceptual design, the submodule, which was the basic replaceable unit for the system, had a capacity of 240 kW-h and consisted of ninety-six 2.5 kW-h cells. However, a study by Rockwell indicated that the cost for battery hardware, $60 to 80/kW-h (cells and converters not included), was too high. Most of this cost was contributed by the submodule structure and the charge equalization scheme, which was the same as that developed for electric-vehicle batteries. In 1979, subsequent efforts were concentrated on lowering these hardware costs and resulted in the development of three modified designs, which are presented in this report. The first, developed at ANL, consisted of a 30 kW-h cell/submodule and the electric-vehicle equalization scheme. The hardware cost for this modified design was quite low, about $25/kW-h; however, this design was eventually rejected owing to the apparent impracticality of such a large cell. The two other modified designs had more conservative cell designs. One of them, developed at ANL, consisted of a 120 kW-h submodule consisting of one hundred 1.2 kW-h cells; the other, developed at Rockwell, consisted of a 1020 kW-h submodule consisting of four hundred and eight 2.5 kW-h cells. For both of these designs, an alternative method of equalization, in which fixed resistance shunts are used on each cell, was proposed; this equalization method adds little equipment cost to the system and only sacrifices about 4% of the coulombic and energy efficiencies. The cost of battery hardware for these two designs was estimated to be acceptable, about $22 to 60/kW-h. Some questions remain on the assumed capabilities of the cells and the feasibility of the battery hardware.

33594 (DOE/ET/26934—1) **Commercialization strategy for lead/acid batteries in utility load leveling applications.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1980. Contract AC01-77ET26934. 159p. NTIS, PC A08/MF A01.

A plan is described that could be implemented by 1985 to 1986 to overcome the initial economic barriers to the commercialization of lead/acid batteries in load leveling applications. The plan is based on the results of previous studies, in particular an assessment of market demand made by MITRE/METREK. The specific financial requirements of both the battery manufacturers and the electric utilities were analyzed and accounted for when developing the approach. Since the success of the program and the costs depend critically on how the prices of different fuels change with time, and these prices could be affected by political decisions, it is left to the judgement of the officials responsible for program priorities to decide whether the benefits that would result from this plan warrant the likely risks or costs to the government.

FUELS

REFER ALSO TO CITATION(S) 33846

33595 (ANL/EES-TM—97) **Environmental assessment of a program to reduce oil and gas consumption by electric utilities.** (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 117p. NTIS, PC A06/MF A01.

An environmental assessment is presented of a program aimed at reducing oil and gas consumption in electric utility power plants by the equivalent of approximately 10^6 barrels per day by 1990. The program would mandate the conversion of 45 power plants (approximately 21 GW) to coal and would provide financial incentives for the accelerated replacement of other existing oil- and gas-fired plants (estimated to be 30 GW) by new coal-fired plants or other acceptable alternatives. The report analyzes the air quality impacts of potential increases in sulfur dioxide, nitrogen oxides, and particulate matter emissions associated with the program. The assessment also considers potential solid waste, coal production and transportation, and public health and welfare impacts. The Coal and Electric Utilities Model (CEUM) of ICF, Incorporated, was used to generate the numerical data on which the assessment is based. Impacts are presented at the national and regional levels, with some discussion of possible local air quality effects of conversion of specific plants.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33712, 33738, 34128

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 34195

33596 (EPRI-EA—1438) **Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography.** Nakamura, S.L.; Dailey, N.S. (Atomic Industrial Forum, Inc., Washington, DC (USA); Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 163p. NTIS, PC A08/MF A01.

An annotated bibliography is presented of almost 600 references dealing with the environmental impacts of closed-cycle cooling systems. The references were extracted from the open literature for the period up to the spring of 1979 and from environmental reports and impact statements prepared for or by the electric utility industry. Topics covered include atmospheric discharges from cooling towers, predicted cumulative effects of releases from energy parks, sensitivity of agricultural crops and native vegetation, salt deposition, aesthetic impacts, atmospheric dispersion and plume behavior, analytical methods and mathematical models and studies to assess the effects of closed-cycle cooling operations. References are arranged by subject category and indexes are provided to authors' names, energy facility names and geographic location of field research.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 34119

33597 (P—300-80-002) **Environmental control technologies for a northern California coal-fired power plant.** (Acurex Corp., Mountain View, CA (USA); SCS Engineers, Inc., Long Beach, CA (USA); CH2M Hill, Sacramento, CA (USA)). Mar 1980. 474p. California Energy Commission, Sacramento.

The Pacific Gas and Electric Company is planning a coal-burning, 1600 MWe steam-electric power plant, Fossil 1 and 2. The two unit facility will use low-sulfur (0.8% average) Western coal and units are planned for operation by July 1985 and 1986. This report presents a technical assessment of pollution control methods for air, solid waste, and water, including their interaction. The air pollution control techniques are evaluated with respect to emissions levels indicated by the California Air Resources Board, CARB, which are twice as stringent as current federal standards. The solid waste disposal study deals with disposal alternatives and associated environmental impacts and costs. Water management alternatives based on wet cooling towers as supplied by various water sources are presented. The study suggests that air pollution control technologies will be available by the mid-1980's to satisfy CARB requirements; that total waste water recycle or zero liquid discharge condition can be achieved if a high quality make-up water supply is utilized; and that chemical waste stabilization in conjunction with ponding in lined disposal sites provides an acceptable waste management system.

SITE SELECTION AND LAND USE

33598 (DOE/RA/23220—01) **Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary.** Schwartz, L.; Wilson, W. (Washington Univ., Seattle (USA). Social Management of Technology Program; National Conference of State Legislatures, Denver, CO (USA); Franklin Pierce Law Center, Concord, NH (USA)). Nov 1979. Contract FG03-78RA23220;AS02-78RA04934. 79p. NTIS, PC A05/MF A01.

This Executive Summary presents observations, conclusions, and recommendations developed from the completion of five (5) case studies of hydroelectric sites at High Falls, Georgia; Traverse City, Michigan; Swanville Lake, Maine; Cornell, Wisconsin; and Maxwell Locks, Pennsylvania. The work was accomplished by the Energy Law Institute of the Franklin Pierce Law Center, Concord, NH, for the National Conference of State Legislatures. The material contained here is, in part, a summary of the five separate reports on the legal and institutional barriers and incentives bearing on the development of each site. It is also a summary of the cumulative impressions of the actual general legal and institutional climate for small-scale hydroelectric development represented by the issues confronting each site. This document provides a general analysis and overview of the significant problems and opportunities for the development of hydroelectric facilities identified in the five full reports. A second Executive Summary is presented on the findings of two case studies of small-scale hydroelectric power at existing dams. The projects reviewed are: six sites in the irrigation system known as the Columbia Basin Project and two sites in the Bull Run watershed which supplies water to the City of Portland, Oregon. Key incentives and impediments are identified in these case studies conducted at the University of Washington.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 33701, 33712, 33740, 33741

33599 (DOE/EIS—0066) **Revised draft environmental impact statement. The role of the Bonneville Power Administration in the Pacific Northwest power supply system, including its participation in a hydro-thermal power program.** (Department of Energy, Washington, DC (USA)). Apr 1980. 590p. NTIS, PC A25/MF A01.

This statement evaluates the environmental impacts associated with the operation and development of the regional power system under various levels of regional cooperation and coordination. Included as part of this analysis are the impacts of these varying institutional arrangements upon the operation of the existing/committed regional system, as well as their effect upon the future development of a coordinated regional power planning program. Those alternatives which advocate a formalized and comprehensive regional decisionmaking process are felt to be environmentally preferable in that they assure the consideration of nonpower interests and maximize the efficient use of the existing system.

33600 (EPRI-EL—1455) **Fundamental investigation of arc interruption in gas flows. Final report.** Benenson, D.M.; Frind, G.; Kinsinger, R.E.; Nagamatsu, H.T.; Noeske, H.O.; Sheer, R.E. Jr. (General Electric Co., Schenectady, NY (USA)). Jul 1980. 231p. NTIS, PC A11/MF A01.

Continuation of the study of thermal recovery in gas blast interrupters reported earlier in EPRI Report EL-284 is reported. The thermal recovery process was investigated with physical and aerodynamic methods, typically using reduced size nozzles and short sinusoidal current pulses. Current-zero dI/dt and gas pressures were representative of full-size interrupters. Aerodynamic characterization of the cold flow fields in several different nozzle types included measurements of the pressure and flow fields, both steady-state and turbulent components, with special attention given to wakes and shock structures. Special schlieren techniques on DC arcs and high-speed photography on arcs in orifice nozzles show that shock heating broadens the arc independent of turbulence effects and producing a poorly recovering downstream arc section. Measured recovery speeds (RRRV) in both orifice and convergent-divergent nozzles agree with predictions of several arc theories assuming turbulent power losses. However, data on post-zero currents and power loss show values much smaller than theoretical predictions. Hydrogen, deuterium, and methane (CH_4) were measured to have thermal recovery speeds up to one hundred times that of SF_6 in the same conditions. Mixtures of SF_6 with CF_4, C_2F_6, He, or N_2 can give fast thermal recovery when used at high total pressure but moderate SF_6 content. Additional work is reported on development of techniques for measurement of arc temperature, and theoretical models for examining arc behavior prior to current zero and the effects of gas composition on recovery speed.

33601 (EPRI-EL—1484) **Superposition gas breakdown. Final report.** Dale, S.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Aug 1980. 15p. NTIS, PC A02/MF A01.

Results are described of a research program investigating breakdown in a 76/250 mm coaxial electrode system in compressed SF_6 as a result of superposition of impulse voltages on the 60 Hz power frequency voltage in the presence of conducting particles. The object of this program was to experimentally determine if impulse superposition is a more severe condition for particle initiated breakdown than the 60 Hz voltage alone, which can result in breakdown as low as only 10% of the dielectric strength of SF_6. Breakdown voltages were measured for particles both isolated and in contact with the center conductor and also for multiple free conducting particles in the system for impulse voltages, 60 Hz voltage and with impulses superposed on the 60 Hz voltage. The results showed that the lowest values obtained with the superposition of impulse voltages on the 60 Hz voltage were equal to the lowest values of the 60 Hz or impulse voltages alone. The probability for particle initiated breakdown as a result of superposed impulse voltages with realistic magnitudes of the 60 Hz voltage was found to be negligible and was entirely dominated by the 60 Hz breakdown probability. It is therefore concluded that tests using impulses superposed on the 60 Hz voltage does not constitute a more severe test condition for the gas insulation of compressed gas insulated systems than the present 60 Hz test voltages. The voltage combination may be useful as a method of field conditioning long lengths of compressed gas insulated transmission systems.

AC SYSTEMS, EHV AND UHV

33602 (CONS—3122-T2) **Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979.** Englehardt, J.; Harris, H.; Kasny, E.; Orifice, D.; Patton, R.; Sottovia, P. (Public Service Electric and Gas Co., Newark, NJ (USA)). Jan 1980. Contract EY-78-C-01-3122. 102p. NTIS, PC A06/MF A01.

One year of research on validating the performance of the Cable Monitoring and Rating System (CMARS) is reported. The performance testing was conducted on underground 230-kV and 345-kV pipe type cable circuits owned by the New Jersey Public Service Electric and Gas Co. Laser temperature monitoring systems and a data acquisition system were installed. Software installation and development is discussed. The CMARS testing program is described. (LCL)

33603 (EPRI-EL—1435) **Impregnation of solid dielectric cable insulation. Final report.** Kiss, K.D.; Mangaraj, D.; Doepken, H.C. Jr. (Phelps Dodge Cable and Wire Co., Yonkers, NY (USA)). Jul 1980. 285p. NTIS, PC A13/MF A01.

Laboratory scale investigations were conducted to assess the feasibility of improving the dielectric characteristics of crosslinked polyethylene (XLPE) insulated cables rated 138 kV and above. Impregnation of slabs cut from 138 kV cables and of model cables with liquids increased the ac breakdown strength, presumably by filling the microvoids (and possibly in some cases acting as a voltage stabilizer) and preventing premature failure due to electrical discharge. The degree of improvement depends on the chemical nature of the impregnant. Vinyl toluene, styrene, styrene oxide and vinyl pyrrolidone were found to increase the dielectric strength substan-

tially and in some cases improve the VT curve. With vinyl toluene, the improved strength is approximately 3750 V/mil compared to 2300 V/mil for the control. In situ polymerization with lauryl methacrylate and vinyl toluene monomers and impregnation with polyethylene wax have proven that the solid polymer is as effective as the liquid monomer. Optical and scanning electron microscopic examination supports the concept of void filling. The volume resistivity of semiconducting shields is not materially affected by the impregnation and polymerization, probably because the carbon black inhibits the polymerization. An economic analysis including raw materials' costs and manufacturing costs suggests that the process of impregnation and polymerization costs somewhat less than lead sheathed, dry cured power cables.

33604 (EPRI-EL—1480) **Controlling biological deterioration of wood with volatile chemicals. Final report.** Graham, R.D.; Corden, M.E. (Oregon State Univ., Corvallis (USA)). Aug 1980. 81p. NTIS, PC A05/MF A01.

Volatile fungicides placed in holes in pressure-treated Douglas-fir transmission poles with internal decay diffuse as vapors for about 2.4 m above and below the groundline to control decay for at least 10 y. The presence of fungitoxic vapors of chloropicrin (trichloronitromethane) in these poles suggests added years of control. Vapam (sodium N-methyldithiocarbamate) was less effective, but both of these chemicals are used nationwide. Methylisotiocyanate (MS), which appears especially promising in both laboratory wood-block screening tests and in poles 2 years after treatment, may prove outstanding as a control for internal decay of poles. Successfully formulated as a solid, MS could increase the safety and versatility of fumigant use. A comparison of devices for inspecting Douglas-fir poles for decay emphasized the importance of having well-trained inspectors who know the limitations of the tools and methods they use. A manual for the maintenance of Douglas-fir and western redcedar poles was published to aid inspectors and managers of wood pole systems. Fumigants varied in their residual protection against invasion by decay fungi with chloropicrin having the highest residual fungitoxicity. Fumigants had no adverse effect on vegetation around poles, nor on the strength properties of wood. Of the 8 decay fungi isolated from over 15,600 pressure-treated Douglas-fir poles, Poria carbonica and Poria placenta were by far the most prevalent. Of the five most prevalent nondecay fungi isolated from these poles, a Scytalidium species can produce an environment unsuitable for reinvasion of the wood by decay fungi. The resistance of the Scytalidium species to chloropicrin raises the possibility of a combined chemical-biological control of internal decay.

33605 (EPRI-EL—1500) **High-temperature gas-insulated systems. Final report.** Dethlefsen, R.; Tahiliani, V.; Hughes, P.; Cronin, J. (Gould-Brown Boveri, Greensburg, PA (USA)). Aug 1980. 252p. NTIS, PC A12/MF A01.

The economic impact of, and the technical requirements for, high temperature operation (140°C) of SF_6-insulated transmission lines are analyzed. Optimized design computer programs incorporate the present worth cost of losses. The cost of losses makes it uneconomic to raise the conductor temperature beyond about 110°C. For the same reason forced cooling is not attractive for steady operation. High temperature operation and forced cooling are attractive for operating flexibility by allowing higher short-term loading. Components for high temperature operation were developed and tested. These are insulators, conductor joints, and spiral-welded enclosures. A 9 m (30 ft.) long section of a 362-kV prototype was built and tested in three modes of installation: open air, covered trench, and direct burial. The steady state and transient ampacity for high temperature operation were measured and compared with calculated data. Thermal radiation accounts for about 15% of the conductor-enclosure heat transfer. High emissivity paint on the interior surfaces can increase the radiative heat transfer by a factor up to six. Forced cooling by circulating the SF_6 gas is practical only for short lines up to 1/2 mile. The prototype enclosure was water cooled by strapping four aluminum tubes to the outside. This increased the buried mode ampacity by only about 50% because the thermal resistance between enclosure and water pipes proved to be to high. Ampacity correction factors for various installation parameters are summarized in the Application Guide of Section 5.

33606 (JPL-PUBL—80-48(Vol.1)) **Study of a Space Communication System for the control and monitoring of the Electric Distribution Syster.. Volume I. Summary final report.** Vaisnys, A. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1980. Contract NAS-7-100-955267. 55p. NTIS, PC A04/MF A01.

The results from a study of a space communication system for electric utility load management are presented. A definition is provided of distribution control and monitoring functions; associated communications traffic is quantified. A baseline conceptual design in terms of operating capability and equipment is described. Some of the more important factors to be considered in designing a system are examined. Preliminary cost data are provided. Factors associated with implementation along with conclusions and recommendations, are discussed.

33607 (JPL-PUBL—80-48(Vol.2)) **Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume II. Supporting data and analyses.** Vaisnys, A. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1980. Contract AC01-79ET29372. 271p. NTIS, PC A12/MF A01.

This volume provides supporting analyses and data from the Study of a Space Communication System for Electric Utility Load Management. The material presents an overview description of the system concept, identifies and defines the functions associated with distribution automation and control, defines communication system requirements, examines important factors related to formulating viable communication concepts, discusses the relationship of various design factors to utility operating practices, reports the results of the cost analysis, and describes several ways in which the concept could be integrated into the utility industry.

DC SYSTEMS

33608 (DOE/ET/29185—17) **Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, April 1, 1980-June 30, 1980.** Long, W.F. (Wisconsin Univ., Madison (USA)). Jul 1980. Contract AS02-78ET29185. 5p. NTIS, PC A02/MF A01.

The activity reported herin is the proposed system study to examine the dynamic relationship of integrated ac/dc systems wherein the existence of direct current circuit breakers is postulated.

33609 (EPRI-EL—1496) **Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report.** Beausejour, Y.; Rizk, F.A.M. (Institut de Recherche de l'Hydro-Quebec, Varennes (Canada)). Aug 1980. 98p. NTIS, PC A05/MF A01.

This project constitutes a continuation of EPRI project 430-1 covering the power supply for insulator pollution testing. The aims of this project are to determine the circuit elements of a controlled cascade rectifier source to perform pollution tests; the effect of the voltage drop and the short-circuit current on the 50% flashover voltage; the reduction of the 50% flashover voltage with increasing pollution severity on insulators; the effect of the dc resistance R/sub dc/ on the 50% flashover voltage; and to study the leakage current behavior during artificial-pollution tests. The circuit elements of a controlled cascade rectifier source were determined on a model circuit and the results were generalized with a computer program. The proper operation of the circuit was verified with a full-scale circuit at 100 kV. The circuit elements of this controlled source were optimized with respect to the estimated total cost of the power supply. Among the major conclusions of the study are the following: a controlled cascade rectifier connected in a voltage doubler arrangement is an adequate power supply for testing insulators under heavy pollution; and the specifications of the hvdc power supply sufficient to determine the 50% flashover voltage of heavily contaminated insulators (ESDD = 0.5 mg/cm^2) within an accuracy of 5% may be expressed as the power supply should have a voltage drop of less than 5% at the highest current of 2 A, and the short-circuit current at the output of the hvdc source should be higher than 10 A. This refers to the quasi-stationary short-circuit current subsequent to the transient discharge of the smoothing capacitor.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

REFER ALSO TO CITATION(S) 34379

NUCLEAR POWER PLANTS

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 33634

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 33632

33610 (CONF-800747—5) **Meeting commercial reactor instrumentation needs.** Stanley, M.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 10p. NTIS, PC A02/MF A01.

From Review group conference on advanced instrumentation for reactor safety research; Oak Ridge, TN, USA (29 Jul 1980).

Commercial nuclear reactors are instrumented for two reasons: (1) to provide information to the operators, and (2) to support automatic safety systems. The key questions the operators want

answered are: Is the core being cooled and what is the temperature. Two instruments currently installed in LOFT are providing these answers. The commercial application of liquid level probes and fuel thermocouples will undoubtably bring argument from some quarters, but properly working instruments of their type will provide the operator assurance of the real status of the plant.

33611 (DOE/ET/34209—T1) **Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow.** Wilson, R.J.; Jones, B.G.; Roy, R.P. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). Feb 1980. Contract AC02-77ET34209. 150p. NTIS, PC A07/MF A01.

An experimental study of the fluctuating velocity field, the fluctuating static wall pressure and the in-stream fluctuating static pressure in an annular turbulent air flow system with a radius ratio of 4.314 has been conducted. The study included direct measurements of the mean velocity profile, turbulent velocity field; fluctuating static wall pressure and in-stream fluctuating static pressure from which the statistical values of the turbulent intensity levels, power spectral densities of the turbulent quantities, the cross-correlation between the fluctuating static wall pressure and the fluctuating static pressure in the core region of the flow and the cross-correlation between the fluctuating static wall pressure and the fluctuating velocity field in the core region of the flow were obtained.

33612 (SAND—80-1428C) **Design concepts to enhance nuclear power plant protection.** Ericson, D.M. Jr.; Varnado, G.B. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 36p. (CONF-801026—1). NTIS, PC A03/MF A01.

From ANS workshop on power plant security; Chicago, IL, USA (5 Oct 1980).

Using a modern design for a nuclear power plant as a point of departure, this study examines the enhancement of protection which may be achieved by changes to the design. These changes include concepts such as complete physical separation of redundant trains of safety equipment, hardened enclosures for water storage tanks, and hardened shutdown heat removal systems. The degree of enhancement (value) is examined in terms such as the potential reduction in the number of vital areas and the increase in probability of adversary sequence interruption. The impacts considered include constraints imposed upon operations and maintenance personnel and increased capital and operating costs. The study concludes that structural design changes alone do not provide significant increases in protection.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 33610, 33611, 33612, 33626, 33632, 33633

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 33857

33613 (GA-A—15942) **US/FRG Umbrella Agreement for Cooperation in GCR Development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, April 1, 1980-June 1, 1980.** Gulden, T.D. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET35300. 17p. NTIS, PC A02/MF A01.

Information is presented concerning fuel development; fission product behavior; and graphite development.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 33630, 33631, 33862, 33889

33614 (JAPFNR—509) **Fast breeder reactor development in Japan. Progress report, January-March 1979.** (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). [nd]. Translation of PNC N251 79-06, November 1979. 20p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

Information is presented concerning the JOYO reactor, the MONJU reactor, reactor physics, development of structural components, instrumentation and control, sodium technology, development of fuel materials, reactor safety, and steam generator development.

33615 (DOE/CEA/BMFT—13) **Review of the CEA research and development activities in the field of structural materials for fast breeder reactors.** (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Div. d'Etudes et de Developpement des Reacteurs). Mar 1979. 73p. (In French). NTIS (US Sales Only), PC A04/MF A01.

Portions of document are illegible.

Brief summaries are presented concerning research programs involving fracture mechanics design data and analysis; alternative materials; DNB water side corrosion; and corrosive effects of sodium.

33616 (DOE/ET/37240—72) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1979. Contract AS02-76ET37240. 88p. NTIS, PC A05/MF A01.

Information is presented concerning bundle geometry with wrapped and bare rods; subchannel geometry with bare rods; LMFBR outlet plenum flow mixing; and theoretical determination of local temperature fields in LMFBR fuel rod bundles.

33617 (ENICO—1046) **Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II.** Maeck, W.J.; Erikson, A.L.; Tromp, R.L. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Jul 1980. Contract AC07-79ID01675. 25p. NTIS, PC A02/MF A01.

Absolute ^{241}Pu fast reactor fission yields are given for the stable and long-lived isotopes of rubidium, zirconium, molybdenum, xenon, cesium, barium, cerium, neodymium, and samarium, for a sample irradiated in Row-4 of the Experimental Breeder Reactor-II. The principal measurement technique for the fission product isotopes was isotope dilution mass spectrometry. The number of fissions was established by summing the number of fission product atoms in the heavy mass peak. Relative fission product isotopic data are given for a sample of ^{239}Pu also irradiated in Row-4 of the Experimental Breeder Reactor-II.

33618 (GA-A—15932) **US GCFR demonstration plant design.** Hunt, P.S.; Snyder, H.J. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 37p. (CONF-800648—12). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

A general description of the US GCFR demonstration plant conceptual design is given to provide a context for more detailed papers to follow. The parameters selected for use in the design are presented and the basis for parameter selection is discussed. Nuclear steam supply system (NSSS) and balance of plant (BOP) component arrangements and systems are briefly discussed.

33619 (HEDL-SA—2112-FD) **Breeder reactor fuel fabrication development overview.** Carlson, M.C.J.; Yatabe, J.M.; McLemore, D.R.; Bennett, D.W.; Graham, R.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 20p. (CONF-800607—83). NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The current breeder reactor fuel assembly is a high quality, proven fuel that is currently manually fabricated using glovebox technology. To provide improved fuel fabrication processes, and to assure meeting increasingly stringent health and safety criteria, an advanced Secure Automated Fabrication (SAF) System is being developed for mixed uranium and plutonium fuel fabrication. SAF System development will ultimately result in systems which maximize personnel radiation protection, restrict and control access to SNM material, improve containment and detection systems for nuclear materials, provide near real-time SNM accountability and improve product uniformity and quality.

33620 (HEDL-TME—79-78) **Hybrid inverse kinetics method combining the Yang-Albrecht and three point techniques.** Francis, J.M.; Savenich, R.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1980. Contract AC14-76FF02170. 55p. NTIS, PC A04/MF A01.

The power history of a subcritical rod drop experiment can be analyzed with a digital computer by a variety of inverse kinetics programs. The Yang-Albrecht Inverse Kinetics technique gives unbiased estimates of source and reactivity values, but no uncertainty estimates. The Three Point Inverse Kinetics method gives uncertainty estimates, but exhibits slight bias in its source and reactivity values. This report blends the two approaches, giving a hybrid algorithm with the best features of the Yang-Albrecht and Three Point techniques.

33621 (IWGFR—29) **Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions. Summary report.** (International Atomic Energy Agency,

Vienna (Austria). International Working Group on Fast Reactors). 1979. 276p. (CONF-780296—). NTIS, PC A11/MF A01.

From Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions; Karlsruhe, F.R. Germany (5 Feb 1978).

The purpose of the meeting was to provide a forum for exchange of information on thermo- and fluiddynamic investigations of LMFBR-subassembly. Special emphasis was placed on nominal and non-nominal conditions. The technical part of the meeting was divided into four sessions, as follows: status of the thermo- and fluiddynamic activities; physical and mathematical modelling of single phase; rod bundle thermohydraulics; experimental investigations; and future R and D. Separate abstracts are included for each of the papers.

33622 (JAPFNR—502) **Research and development of bellows for LMFBR in Japan.** Takahashi, T.; Mukai, K.; Yamamoto, K. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Nov 1979. 13p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

Bellows are employed in the fast experimental reactor JOYO which is now in operation and the fast prototype reactor MONJU. In addition, the application of bellows as thermal expansion joint to the main piping system is under consideration for future FBRs. This paper outlines the research and development work on bellows for the FBR use in Japan.

33623 (JAPFNR—503) **UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly.** Miyaguchi, K. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Jan 1979. 12p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

In several countries many experimental and analytical studies have been performed to investigate local blockage problems in LMFBR subassemblies, and even 3 dimensional computer codes have been developed. The numerical results of these codes are qualitatively correct, but it seems that they are not yet quantitatively verified by experiments. In the Oarai Engineering Center, PNC, Japan a series of hydraulic simulation experiments and the experiments in sodium-cooled, electrically heated bundles have been conducted, and in parallel with experimental studies analytical codes have been developed. The purpose of the present paper is to describe one of these codes, UZU which calculates flow and temperature fields in the wake behind a blockage in a pin bundle.

33624 (JAPFNR—506) **Investigation on the reliability of expansion joint for piping with probabilistic method.** Ishii, Y.; Kambe, M. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Nov 1979. 23p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

The significance of expansion joint with multiple boundaries, and the breakdown probability of expansion joint assembly and the bellows by introducing several hypothetical conditions in connection with piping are discussed. Also, an importance of inservice inspection (ISI) for expansion joint was discussed. The expansion joint with ISI should be manufactured with excellent reliability in order to cope with piping work system, and several conditions of the practical application for piping systems are suggested.

33625 (JAPFNR—507) **Development of bellows for sodium valve in Japan.** Tanigawa, S.; Mukai, K.; Fukada, T.; Takahashi, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Nov 1979. 36p. NTIS (US Sales Only), PC A03/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

Sodium valves for FBR are required to isolate sodium side from the atmosphere completely throughout its lifetime because of preventing sodium leakage with or without radioactivity. A great number of sodium valves have been used in FBR test facilities at O-arai Engineering Center of PNC and many troubles have been occurred through their operational experience. Most of the cause of the troubles are the bellows failure followed by sodium leakage. In this report some examples of the investigation of failed bellows occurred at O-arai Engineering Center of PNC are described. The research and development program on bellows is also explained with the summary of recent test results.

REGULATION AND LICENSING

33626 (UCID—18672) **Technical evaluation of the proposed technical specification change for the North Anna Nuclear Power Station, Unit 1.** Victor, R.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jun 1980. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01.

This report documents the technical evaluation of the request for an amendment to Operating License NPF-4 for changes in the Technical Specifications for the North Anna Power Station, Unit 1. These changes were proposed by the licensee, Virginia Electric and Power Company, in its submittal of October 13, 1978. The basis for review included a report entitled Westinghouse Reactor Protection System/Engineered Safety Features Actuation System Setpoint Methodology. The requested changes to the Technical Specifications are found to be acceptable based on the information submitted by the licensee.

ECONOMICS

REFER ALSO TO CITATION(S) 33689

33627 (PNL-SA—8017) **Optimization of costs versus radiation exposures in decommissioning.** Konzek, G.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 17p. (CONF-790923—12). NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

The estimated worth of decommissioning optimization planning during each phase of the reactor's life cycle is dependent on many variables. The major variables are tabulated and relatively ranked. For each phase, optimization qualitative values (i.e., cost, safety, maintainability, ALARA, and decommissioning considerations) are estimated and ranked according to their short-term and long-term potential benefits. These estimates depend on the quality of the input data, interpretation of that data, and engineering judgment. Once identified and ranked, these considerations form an integral part of the information data base from which estimates, decisions, and alternatives are derived. The optimization of costs and the amount of occupational radiation exposure reductions are strongly interrelated during decommissioning. Realizing that building the necessary infrastructure for decommissioning will take time is an important first step in any decommissioning plan. In addition, the following conclusions are established to achieve optimization of costs and reduced occupational radiation exposures: the assignment of cost versus man-rem is item-specific and sensitive to the expertise of many interrelated disciplines; a commitment to long-term decommissioning planning by management will provide the conditions needed to achieve optimization; and, to be most effective, costs and exposure reduction are sensitive to the nearness of the decommissioning operation. For a new plant, it is best to start at the beginning of the cycle, update continually, consider innovations, and realize full potential and benefits of this concept. For an older plant, the life cycle methodology permits a comprehensive review of the plant history and the formulation of an orderly decommissioning program based on planning, organization, and effort.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 33809

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

33628 (ORNL/TM—7305) **Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis.** White, J.R. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 179p. NTIS, PC A09/MF A01.

Thesis. Submitted to the Univ. of Tennessee, Knoxville, TN.

A generalized depletion perturbation formulation based on the quasi-static method for solving realistic multicycle reactor depletion problems is developed and implemented within the VENTURE/BURNER modular code system. The present development extends the original formulation derived by M.L. Williams to include nuclide discontinuities such as fuel shuffling and discharge. This theory is first described in detail with particular emphasis given to the similarity of the forward and adjoint quasi-static burnup equations. The specific algorithm and computational methods utilized to

solve the adjoint problem within the newly developed DEPTH (Depletion Perturbation Theory) module are then briefly discussed. Finally, the main features and computational accuracy of this new method are illustrated through its application to several representative reactor depletion problems.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 33863

CONTROL SYSTEMS

33629 (CONF-801107—6) **Meeting the reactor operator's information needs using functional analysis.** Nelson, W.R.; Clark, M.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 4p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Since the accident at Three Mile Island, many ideas have been proposed for assisting the reactor operator during emergency situations. However, some of the suggested remedies do not alleviate an important shortcoming of the TMI control room: the operators were not presented with the information they needed in a manner which would allow prompt diagnosis of the problem. To address this problem, functional analysis is being applied at the LOFT facility to ensure that the operator's information needs are being met in his procedures and graphic displays. This paper summarizes the current applications of functional analysis at LOFT.

33630 (JAPFNR—508) **Bellows for control rod drive mechanism of MONJU.** Matsumoto, S.; Ogawa, T.; Ishii, Y.; Yamagishi, Y.; Suzuki, F. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Nov 1979. 19p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

The full mock-up operation test of Control Rod Drive Mechanism (CRDM) for MONJU have been carried on since 1972 in OEC of PNC. Welded type bellows were adopted for CRDM as the boundary between sodium and atmosphere. In design, two different locations were considered for bellows, one in sodium and the other in argon gas with sodium vapor and some experiences on the bellows have been obtained. Besides the prototype tests of CRDM, several R and D on CRDM bellows, such as environment effect test and endurance test are conducted.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 33629, 34090, 34092

REACTOR SAFETY

33631 (CLM-P—582) **General formulation of the isotherm migration method for reactor accident analysis.** Turland, B.D. (UKAEA Culham Lab., Abingdon). Jun 1979. 15p. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-UKAEA Fast Reactor Exchange Program.

The purpose of the work to be described was to develop an accurate and efficient numerical method to model melting attack on reactor structures following a hypothetical accident. To this end, the isotherm migration method (IMM) has been investigated. In the IMM the change in location of a set of isotherms is followed with time; mathematically this is equivalent to a change of dependent variable. The method has advantages over classical numerical techniques for problems involving the passage, with possible broadening, of a thermal front through a medium and in the treatment of melting and freezing problems, since the phase change temperature may be chosen as one of the set of isotherms. The method also provides a way of handling temperature dependent thermal properties simply and efficiently.

33632 (CONF-800747—4) **Instrumentation needs in LWR severe fuel damage experiments.** McCormick, R.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 22p. NTIS, PC A02/MF A01.

From Review group conference on advanced instrumentation for reactor safety research; Oak Ridge, TN, USA (29 Jul 1980).

The Class 9 type nuclear accident is defined and the Three Mile Island type accident and proposed Idaho National Engineering Laboratory experiment series are described in some detail. Different types of severe fuel damage experiments are briefly discussed in order to show typical measurement requirements. General instrumentation needs and problems encountered in Class 9 accident research are outlined. It is concluded that the extremely high temperatures, high nuclear radiation fields, and oxidizing atmosphere will necessitate instrument development programs. Noncontact type sensing will be necessary in most of the molten core experiments.

33633 (DOE/TIC—11235) **Three Mile Island: then and now.** Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

A review of the Three Mile Island Unit 2 accident is presented. Current activities to clean up the reactor are described.

33634 (UCRL—81944) **Development of the seismic input for use in the seismic safety margins research program.** Bernreuter, D.L.; Chung, D.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jan 1980. Contract W-7405-ENG-48. 9p. (CONF-800919—1). NTIS, PC A02/MF A01.

From 7. world conference on earthquake engineering; Istanbul, Turkey (8 Sep 1980).

This paper briefly outlines the overall systems approach being developed for the Seismic Safety Margins Research Program. The unique features of the approach being taken to reduce the uncertainty in the seismic input for this program are discussed. These unique features will include extensive use of expert opinion, earthquake rupture simulation studies and the way in which the seismic hazard is incorporated into the overall systems analysis. Some very preliminary results are also given for the Zion site which is the power plant chosen for analysis in Phase I of the program.

ENERGY STORAGE

COMPRESSED GAS

33635 (PNL—3399) **Experimental study of the response of the Galesville sandstone to simulated CAES conditions.** Erikson, R.L.; Stottlemyre, J.A.; Smith, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01.

The objective of this experimental study was to determine how the mineralogical and physical characteristics of host rock formations are affected by environmental conditions anticipated for compressed air energy storage (CAES) in porous, permeable rock. In this study, Galesville sandstone cores were reacted in autoclave pressure vessels supporting one of four environments: dry air; heated, air-water vapor; heated, nitrogen-water vapor mixtures; and heated, compressed, liquid water. The simulated CAES environments were maintained in autoclave pressure vessels by controlling the following independent variables: temperature, pressure, time, oxygen content, carbon dioxide content, nitrogen content, and liquid volume. The dependent variables studied were: apparent porosity, gas permeability, water permeability, and friability. These variables were measured at ambient temperature and pressure before and after each sandstone sample was reacted in one of the CAES environments. The experiments gave the following results: the Galesville sandstone exhibited excellent stability in dry air at all temperatures tested (50° to 300°C); and significant physical alterations occurred in sandstone samples exposed to liquid water above 150°C. Samples shielded from dripping water exhibited excellent stability to 300°C; sandstone may be a suitable storage media for heated, humid air provided elevated temperature zones are relatively free of mobile liquid water; and observed changes in the physical properties of the rock may have been caused, in part, by the lack of confining stress on the sample. The inability to apply confining pressure is a severe limitation of autoclave experiments.

FLYWHEELS

33636 (COO—4094-91) **Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system.** Hay, R.D.; Millner, A.R.; Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET20279. 9p. (CONF-801022—2). NTIS, PC A02/MF A01.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

A subscale prototype of a flywheel energy storage and conversion system for use with photovoltaic power systems of residential and intermediate load-center size has been designed, built and tested by MIT Lincoln Laboratory. System design, including details of such key components as magnetic bearings, motor generator, and power conditioning electronics, is described. Performance results of prototype testing are given and indicate that this system is the equal

of or superior to battery-inverter systems for the same application. Results of cost and user-worth analysis show that residential systems are economically feasible in stand-alone and in some utility-interactive applications.

33637 (DOE/ET/20279—102) **Dynamic analysis of a magnetically suspended energy storage wheel.** Bucciarelli, L.L.; Rangarajan, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET20279. 7p. (CONF-801022—3). NTIS, PC A02/MF A01.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

The results of an analysis conducted in support of the design of a 1-kWh flywheel fabricated and tested recently at the MIT Lincoln Laboratory are presented. The flywheel is a prototype of a 40-kWh residential unit that will be used to store energy obtained from photovoltaic arrays. The 1-kWh system is designed to operate between 7500 and 15,000 rpm. The flywheel, made of seven 15-inch-diameter steel disks, weighs about 400 pounds, and is suspended vertically by a flexible quill shaft from a set of six magnetic bearings. The magnetic bearings minimize frictional losses and should require little maintenance over the design life of the system. The quill shaft, which permits self-alignment of the wheel's principal axis with the spin axis, was sized so that there are no critical frequencies in the operating range. An integral motor/generator unit is used to spin the wheel up when power is available and to generate power when required. The analysis describes the methods used to obtain: (1) whirl modes and frequencies as a function of spin-rate using the normalized eigenvectors of the system at rest (spin-rate = 0.0); (2) dynamic response for given damping and flywheel imbalances; and (3) estimates of the amount of internal (hysteretic) damping that can cause self-excited instabilities. Results of the analysis compare well with preliminary test results.

33638 (SAND—80-7019) **Flywheel Seal Test Program.** Blackburn, C.M. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). May 1980. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

The original program called for the evaluation of a single seal assembly at a variety of rotational speed and vacuum conditions. Because of difficulties experienced with the first seal, and after consultation with the manufacturer, a second unit was obtained during the program. The test program included a large number of meticulous disassembly and mechanical adjustment operations aimed at isolating the cause of inconsistent torque data. Although some acceptable torque measurements were eventually obtained, there was occasional evidence of mechanical interference between the stationary and rotating seal components. Neither of the seals tested was capable of sealing one atmosphere against the design pressure of 10^{-3} to 10^{-4} Torr, possibly because of internal interference problems. At the conclusion of the program, one seal and its test fixture were returned to the manufacturer for post-testing examination. The manufacturer concluded in a subsequent letter that due to the high sensitivity of this unit to alignment, the first prototype hardware supplied to APL will not produce favorable results, even with further modifications. It is believed that the difficulties encountered with these seals were largely the result of the tight axial tolerances, and do not necessarily indicate any basic problem with the seal concept. It would appear that additional tests would be warranted provided that the dimensional problems can be satisfactorily resolved.

33639 (Y/DX—135) **Data analysis techniques used at the Oak Ridge Y-12 Plant Flywheel Evaluation Laboratory.** Steele, R.S. Jr.; Babelay, E.F. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 14 Jul 1980. Contract W-7405-ENG-26. 14p. (CONF-801022—1). NTIS, PC A02/MF A01.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Since April 1979 the Oak Ridge Flywheel Evaluation Laboratory at the Oak Ridge Y-12 Plant in Oak Ridge, Tennessee, has applied several advanced data analysis techniques to the problem of experimentally evaluating the performance of high-performance composite flywheels. Some of the more advanced techniques used and examples of these techniques are presented. Real-time applications include polar plots of runout with interruptions relating to balance and relative motions between parts, radial growth measurements, and temperature of the spinning part. The technique used to measure torque applied to a containment housing during flywheel failure is also presented. The discussion of pre- and post-test analysis techniques includes resonant frequency determination with modal analysis, waterfall charts, and runout signals at failure.

THERMAL

REFER ALSO TO CITATION(S) 33456, 33539, 33540, 33541

33640 (AD-A—076414) **Phase change/heat storage materials data compilation. Final technical report, August 1978-January 1979.** Hunter, V.R.; Block, R.F. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Jun 1979. Contract F33615-78-C-5081. 52p. NTIS, PC A04/MF A01.

A survey of available phase change heat storage materials for space temperature control applications. A list of thirty one, low-to-medium temperature (100 to 800 F) phase change storage materials are recommended as prime candidates for limiting component temperature excursions during a laser threat. Appendices are provided that include a data compilation of over 200 phase change heat storage materials, a list of data references, a phase change material bibliography and more descriptive information on the prime heat storage material candidates.

33641 (DOE/CS/35760—T1) **Development of intermediate temperature thermal storage systems. Final technical report, April 1, 1978-May 31, 1979.** Moszynski, J.R.; Gueceri, S.I.; Lou, D.Y.S.; Tietbohl, G.L. (Delaware Univ., Newark (USA). Dept. of Mechanical and Aerospace Engineering). 1979. Contract AS05-78CS35760. 63p. NTIS, PC A04/MF A01.

Attention was focused during the period covered on prospective heat storage materials in the temperature range from 100 to 300°C for use with residential air conditioning systems. Special instruments were designed, tested and commissioned during the period. These include: (1) two cells for the determination of the heat of fusion of large scale samples; (2) a cell for the determination of thermal diffusivity; and (3) a device for automatic thermal cycling of large samples. A set of criteria was established for the selection of potential storage materials from the point of view of cost, safety, and suitability for systems under development (temperature ranges of 110 to 130°C, 150 to 170°C and approximately 300°C. A comparison of the storage capacities of two most promising evaporating liquids (water and ethylene glycol) with storage in rock-type materials showed a clear inferiority of the former and that type of storage was dropped from consideration. Four materials were identified as most promising, i.e., sodium-aluminum chloride $NaAlCl_4$, a eutectic mixture of $FeCl_3$ and NaCl, zinc chloride $ZnCl_2$, and a eutectic mixture of NaOH and Na_2CO_3. The four materials listed were subjected to detailed calorimetric studies aimed at the determination of the melting point, heat of fusion, specific heats of the liquid and the solid and any subcooling on solidification. All the materials were subjected to repeated heating and cooling cycles. For the $FeCl_3$-NaCl eutectic, the thermal diffusivity was determined and the compatability with prospective containment materials was investigated.

33642 (DOE/JPL—1060-12(Vol.2), pp 29-37) **Description of the thermal and thermochemical energy storage program.** Gahimer, J. 15 Feb 1979.

In Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers.

Slides for a talk on the thermal and thermochemical energy storage program are reproduced. System schematics for storage for industrial heat recovery, chemical heat pump storage, residential and small commercial heating and cooling storage, and thermal storage for electric power generation are included. (WHK)

CHEMICAL

REFER ALSO TO CITATION(S) 33352

BATTERIES

REFER ALSO TO CITATION(S) 33593, 33594, 33826

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 33655

33643 **Electricslly rechargeable battery.** Adams, G.B. (to Lockheed Missiles and Space Co., Inc.). US Patent 4,180,623. 25 Dec 1979. Filed date 28 Jul 1978. 12p.

An electrically rechargeable battery comprises an inert cathode, a zinc anode, and an aqueous alkaline electrolyte, for example, NaOH, in which the anode and cathode are immersed. The alkaline electrolyte in the vicinity of the cathode contains an alkali metal ferricyanide salt, such as $K_3Fe(CN)_6$ or $Na_3Fe(CN)_6$. Optionally, a mechanical separator is utilized between the anode and cathode to prevent gross mixing of the saturated electrolyte at the cathode with the electrolyte in the vicinity of the anode. Preferably, the separator is of the ion exchange type. During electrical discharge at the anode and cathode, the battery produces soluble reaction products that are transported in the electrolyte to respective external storage tanks that increase battery capacity. During the charge cycle, the reverse conditions occur. 3 figures.

33644 Method of precharging rechargeable metal oxide-hydrogen cells. Kordesch, K.V. (to Union Carbide Corp.). US Patent 4,174,565. 20 Nov 1979. Filed date 28 Mar 1978. 4p.

A rechargeable cell having a metal oxide positive electrode and a hydrogen gas negative electrode is manufactured in accordance with the present invention with a predetermined quantity of hydrogen gas by inserting a metallic member, selected from the group consisting of aluminum, zinc, and magnesium, within the cell at a location adapted to contact the aqueous alkaline electrolyte and hermetically sealing the cell. 1 figure.

33645 Air battery and electrochemical method. Warszawski, B. (to Societe Generale de Constructions Electriques et Mecaniques Alsthom). US Patent 4,172,924. 30 Oct 1979. Priority date 19 Jul 1974, France, 14p.

A method and apparatus for electrochemically producing electricity are described. Ion conductivity is established between an oxygen-reducing electrode, an adjacent ion-pervious insulating membrane, a paste that has flow characteristics comprising particles of an oxidizable metal and a liquid electrolyte, and an inert electrode in physical contact with the paste. In the paste, the metal particles are in an amount constituting from 60% up to the critical pigment volume composition. The metal paste is moved from a first reservoir through the electrochemical battery wherein it is oxidized to the corresponding metal oxide pastee and passed to a second reservoir. The battery may be recharged by reversing the movement and electrolyzing, or by reducing the metal oxide past in an external circuit.

33646 Apparatus and method for stacking battery plates and separators. Eberle, W.J. (to General Battery Corp.). US Patent 4,168,772. 25 Sep 1979. Filed date 1 Jul 1976. 18p.

Battery plate elements and separator elements are maintained in racks along opposite sides of a conveyor. Pivotally swingable vacuum pickup heads serve to withdraw plates and separators from their racks and deposit them onto the conveyor. A plurality of plates or separators are withdrawn simultaneously, and the conveyor is indexed from withdrawal station to withdrawal station for stacking the plates and separators one upon the other, alternately, whereby at any given time a plurality of plate and separator sandwiches are being formed, in different progressive stages. Capability is provided for adjustments for handling different-sized plates and separators as well as the number of elements in a given stack. Synchronous drive means and adjustable vacuum means are disclosed.

33647 Battery cell soldering apparatus. Alvarez, O.E. US Patent 4,169,223. 25 Sep 1979. Filed date 24 Mar 1978. 8p.

A battery cell soldering apparatus for coupling a plurality of battery cells within a battery casing comprises a support platform and a battery casing holder. The support platform operatively supports a soldering block including a plurality of soldering elements coupled to an electrical source together with a cooling means and control panel to control selectively the heating and cooling of the soldering block when the battery cells within the battery casing are held inverted in operative engagement with the plurality of soldering elements by the battery casing holder.

33648 Iron/air battery system having circulating electrolyte and a horizontal cell configuration. Buzzelli, E.S. (to Westinghouse Electric Corp.). US Patent 4,168,349. 18 Sep 1979. Filed date 27 Apr 1978. 6p.

A horizontally disposed iron/air battery cell comprises two horizontally disposed air electrodes having air- and electrolyte-contacting sides and side casings for holding the air electrodes. The air electrodes and side casings define an electrolyte compartment containing electrolyte and a horizontally disposed iron electrode, with one casing side having at least one electrolyte inlet, and the opposite casing side having at least one electrolyte outlet. The cell is operated by supplying air to the air side of the air electrode, and circulating electrolyte through a pump and then through the electrolyte compartment of the cell. The total cross-sectional area of the outlet is 1.25 to 5 times greater than the total cross-sectional area of the inlet. This cross-sectional difference causes the pressure on the electrolyte-contacting sides of the air electrodes to be between 0.5 psi to 6.5 psi less than the pressure on the air sides of the air electrodes. 5 figures.

33649 Nickel-cadmium cell and method for precharging negative electrode of nickel-cadmium alkaline storage cell. Bonnaterre, R. (to Saft-Societe des Accumulateurs Fixes et de Traction). US Patent 4,166,886. 4 Sep 1979. Priority date 5 Dec 1977, France, 6p.

A method for precharging the negative electrode of a nickel-cadmium alkaline storage cell the electrodes of which are assembled in an at least partially discharged state is disclosed. Before the first charge of the cell, a calculated quantity of a material is introduced in the cell, such material being irreversibly oxidizable in an alkaline medium at a potential such that it is anodically oxidized before nickel hydroxide without evolving any gas; then the cell is charged in the normal way. The material preferably is an organic material of the general formula C/sub x/H/sub y/O/sub z/, most preferably where $x = n$, $y = 2n + 2$, and $z = 1$, with n less than 4. This particular class of materials comprises the three saturated mono-alcohols: methanol, ethanol, and propanol. 2 tables.

33650 Electrochemical generators with auxiliary cathode. Durand, P. (to Compagnie Generale des Etablissements Michelin). US Patent 4,136,232. 23 Jan 1979. Priority date 6 Aug 1976, France, 12p.

In an electrochemical generator having two cells, the anode collector of a first of the cells is connected electrically to the cathode of the second cell. The generator comprises means for creating, through the anode compartments of the cells, a flow, in series, of a liquid electrolyte containing particles formed of an anode-active metal, and is characterized in that the cathode compartment of the second cell comprises an auxiliary cathode capable of creating electric current lines localized substantially at one end of the anode collector of the second cell, such end being hydraulically the closest to the anode collector of the first cell.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 33453

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 33649, 33836

33651 Rechargeable zinc halogen battery. Spaziante, P.M.; Nidola, A. (to Diamond Shamrock Technologies). US Patent 4,181,777. 1 Jan 1980. Filed date 7 Sep 1978. 10p.

A rechargeable zinc halogen battery has an aqueous electrolyte containing ions of zinc and halogen and an amount of polysaccharide and/or sorbitol sufficient to prevent zinc dendrite formation during recharging. The electrolyte may also contain trace amounts of metals such as tungsten, molybdenum, and lead. 7 tables.

33652 Method and apparatus for determining the capacity of lead acid storage batteries. Eby, R.L. (to Anderson Power Products, Inc.). US Patent 4,180,770. 25 Dec 1979. Filed date 1 Mar 1978. 10p.

A method and apparatus for determining the capacity of lead-acid storage batteries are disclosed. The initial open circuit voltage of the battery is stored in a settable memory. Thereafter, the open circuit voltage values of the battery throughout the discharge period are determined by measuring loaded voltages with reference to the stored open circuit voltages to detect the discharge rates. The rates of discharge are used to reset the stored value of the initial open circuit voltage measurement. The memory output value is a function of the capacity of the battery. During the charge period, the charge voltages are measured with reference to the stored open circuit voltages to detect the charge rates. The rates of charge are used to reset the stored value of an initial open circuit voltage measurement. Again, the memory output value is a function of the capacity of the battery.

33653 Battery strap and post cast-on multi use mold. Cattano, J.D. (to Dale Products, Inc.). US Patent 4,175,725. 27 Nov 1979. Filed date 10 Nov 1977. 14p.

A composite mold construction for casting on the connector straps, posts, and terminals for lead-acid electrical storage batteries according to the techniques of US Pat. Nos. 3,718,174 and 3,802,488 is described wherein the mold cavity areas are alternately heated by direct flame on one face and then chilled by a coolant on their opposite face to freeze metal in the cavities without freezing molten metal flowing in adjacent flow channels. A plurality of mold cavity partition inserts are arranged to be interchangeable in the main mold assembly to enable a single mold assembly to be utilized for several arrangements of battery cells, strappings, and terminals. Thermal distortion of the mating parts is minimized to maintain the cavities free of leaks by interfitting under cuts and pinned or otherwise keyed couplings between the relatively thin inserts and the more massive primary portions of the mold assembly. 8 figures.

33654 Fabrication of alkaline batteries. O'Sullivan, T.D. (to Bell Telephone Labs., Inc.). US Patent 4,176,021. 27 Nov 1979. Filed date 27 Dec 1978. 6p.

A process is described for loading nickel electrodes in porous plaques through use of an electrolytic technique. The process involves use of a counter electrolyte covered with a cobalt compound. This process is highly efficient because fewer hydrogen ions are liberated during the impregnation process and less buffering substance is needed to stabilize the pH of the solution. 2 tables.

33655 Electric storage batteries. Ramsbottom, E.; Whalley, W.; Bale, E. (to Chloride Group Ltd.). US Patent 4,174,004. 13 Nov 1979. Priority date 15 Feb 1977, United Kingdom of Great Britain and Northern Ireland (UK), 10p.

There is disclosed a plant for pasting battery plates comprising a pasting machine comprising a flat conveyor belt and paste

applying means for forcing paste into a grid conveyed on the conveyor past the paste applying means, grid feeding means, and a transportable hopper and mechanical discharge means for mechanically discharging paste into the inlet to the pasting machine, paste recycling means adapted mechanically to collect paste applied to the conveyor and to convey it back to the inlet to the pasting machine, and a drying oven. 7 figures.

33656 Battery charger with liquid crystal charge current indicator. Sugalski, R.K.; Blake, C.R. (to General Electric Co.). US Patent 4,173,733. 6 Nov 1979. Filed date 30 May 1978. 6p.

A charging system for alternatively charging cells having different physical sizes and/or electrical characteristics comprises a charge current source, a plurality of cell-holder modules, and interconnection means on the charger and modules for selective alternative connection of each of the modules to the charger. Each module includes a liquid crystal indicator for indicating when cells in the module are being charged. 9 figures.

33657 Circuits for heating storage batteries. Sinclair, W. (to Lucas Industries Ltd.). US Patent 4,171,508. 16 Oct 1979. Filed date 8 Dec 1977. 2p.

A battery heating circuit comprises a transformer having a primary winding for connection to an ac supply and a secondary winding, and at least two pairs of batteries. The two batteries of each pair are connected in series, and the series combinations of the pairs of batteries are connected in parallel between dc terminals. The secondary winding is connected between the common terminals of each pair of batteries.

33658 Double seal for sodium sulfur battery. Topouzian, A. (to Ford Motor Co.). US Patent 4,169,919. 2 Oct 1979. Filed date 26 Oct 1978. 6p.

A seal for a sodium/sulfur battery is disclosed in which the sealing is accomplished by two radial compression seals located one above the other on a ceramic component of the battery that separates an anode compartment from a cathode compartment of the battery.

33659 Sulfur electrode for sodium-sulfur batteries. Miller, F.C. (to Great Lakes Carbon Corp.). US Patent 4,169,120. 25 Sep 1979. Filed date 15 May 1978. 4p.

A sulfur electrode for a sodium-sulfur secondary battery comprises a carbonized chopped graphite fiber-resin composite structure impregnated with sulfur.

33660 Lead-acid storage battery having Pb-Cd-Zn-Sn plate straps. Clague, R.E.; Hammar, R.H. (to General Motors Corp.). US Patent 4,169,192. 25 Sep 1979. Filed date 21 Aug 1978. 6p.

A maintenance-free lead-acid storage battery includes substantially antimony-free plate straps cast from an alloy consisting essentially of about 0.01 to about 1.5% by weight cadmium, about 0.4 to 1.5% by weight zinc, about 0.2 to 0.7% by weight tin and the balance lead.

33661 Explosion resistant battery cover design. Oxenreider, T.R.; Heiser, J.I. (to General Battery Corp.). US Patent 4,168,350. 18 Sep 1979. Filed date 23 Nov 1977. 8p.

A maintenance-free battery having explosion-resistant characteristics for multicelled battery containers is described. A battery cover has a main body with an elongate recess in it extending across its length. Within the first recess there are a plurality of vent well openings extending into the cells of the battery and a plurality of vent plugs filling each opening that provide for the escape of gas and retard the escape of electrolyte. A recess plate fits snugly within the recess, the plate attaching to each of the vent plugs. Provisions are made to insure that the ends of the plate seal off the ends of the recess to prevent the leakage of gas between the plate ends and recess end walls. 6 figures.

33662 Halogen electrodes and storage batteries. de Nora, V.; Spaziante, P.M. (to Diamond Shamrock Technologies S.A.). US Patent 4,167,607. 11 Sep 1979. Filed date 19 Dec 1977. 18p.

A composite halogen electrode for a rechargeable metal-halogen energy storage cell comprises a thin foraminous sheet, typically a valve metal with an electroconductive and electrocatalytic nonpassivating coating, in electrical contact over substantially the entire electrode surface with a porous fluid-permeable body (for example, of carbon fibers or sintered valve metal particles) and having throughout its porous structure an active surface coating of electroconductive and electrocatalytic nonpassivating material forming a three-dimensional percolating electrode. The foraminous sheet faces an opposing consumable electrode of a storage cell or battery. During charging halogen evolves essentially at the surface of this sheet, and during discharge halogen contained in an electrolyte is ionized as it percolates through the porous body. 5 figures, 3 tables.

ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 33757, 33787, 33788, 33816, 34439

33663 (DOE/IA—0010/2) **International energy indicators.** Bauer, E.K. (ed.). (Department of Energy, Washington, DC (USA)). Aug 1980. 30p. NTIS, PC A03/MF A01.

Data are compiled in tables and graphs on Iran and Saudi Arabia: Crude Oil Capacity, Production, and Shut-in, June 1974 to July 1980; OPEC (Ex-Iran and Saudi Arabia): Capacity, Production, and Shut-in, June 1974 to June 1980; Non-OPEC Free World and US Production of Crude oil, January 1973 to May 1980; Oil Stocks: Free World, US, Japan, and Europe (landed), 1973 - 1st quarter 1980; Petroleum Consumption by Industrial Countries, January 1973 to February 1980; USSR Crude Oil Production, January 1974 to July 1980; Free World and US Nuclear Generation Capacity, January 1973 to June 1980; US Import of Crude Oil and Products, January 1973 to July 1980; Landed Cost of Saudi Crude in Current and 1974 Dollars, April 1974 to May 1980; US trade in Coal, January 1973 to June 1980; Summary of US Merchandise Trade, 1976 to June 1980; and Energy/GNP Ratio, 1974-1st quarter 1980. The highlight of each is summarized very briefly in the Table of Contents.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 33368, 33673, 33691, 33710, 33713, 33714, 33715, 33716, 33717, 33718, 33719, 33722, 33723, 33724, 33762, 33763, 33764, 33775, 33779, 34131

33664 (BNL—51126) **Modeling approaches to long-run integrated technological impact analysis.** Groncki, P.J. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01.

Analysis of the energy-economic-environmental impacts of energy policies, such as a major synthetic fuels program, requires methodologies that reflect the potential benefits and costs of proposed policy alternatives. Energy policies typically have secondary economic and environmental effects as well as direct effects on energy itself, and these must collectively be assessed to provide a complete basis for policy selection. The focus of this report is on approaches to the analysis of long-term impacts that may result from current decisions regarding energy policy. The interrelationships among the energy, economic, and environmental systems and alternative ways of analyzing long-term impacts within an integrated framework are discussed. An application of such a framework to the assessment of a major synthetic fuels program is presented as an example. The use of idealized problem formulations is a necessary part of technology assessment, particularly in considering highly integrated policy issues, such as a synfuels policy. Nonquantifiable factors, such as equity, are not always considered in mathematical models. Model results should be viewed only as aids for decision making among policy alternatives, as they may not take into account all of the policy's implications. A decision maker must recognize the limitations to using model outputs and must use both experience and judgement in selecting policy alternatives for implementation. Use of an appropriate model structure with sufficient feedback capabilities will often provide a better overall policy assessment than a highly detailed but uncoordinated approach to the same problems.

33665 (BNL—51199) **Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL).** Kydes, A.S. (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 16p. NTIS, PC A02/MF A01.

The two principal energy system models used in the National Center for Analysis of Energy Systems at Brookhaven National Laboratory are described and their important differences are contrasted.

33666 (LBL—11183) **Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979.** Ritschard, R.L.; Haven, K.F.; Ruderman, H.; Sathaye, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 81p. NTIS, PC A05/MF A01.

The purpose of the workshop was to identify and evaluate approaches to regional economic and energy supply/demand forecasting that are best suited to assisting DOE in the assessment of environmental impacts of national energy policies. Specifically the DOE Office of Technology Impacts uses models to assess the impacts of technology change; to analyze differential impacts of various energy policies; and to provide an early-warning system of possible environmental constraints to energy development. Currently, OTI employs both a top-down model system to analyze national scenarios and a bottom-up assessment conducted from a regional

perspective. A central theme of the workshop was to address the problem of how OTI should integrate the top-down and bottom-up approaches. The workshop was structured to use the experience of many fields of regional analysis toward resolving that problem. For the short-term, recommendations were suggested for improving the current OTI models, but most of the comments were directed toward the development of a new methodology. It was recommended that a core set of related models be developed that are modular, dynamic and consistent: they would require an inter-industry accounting framework; inter-regional linkages; and adequate documentation. Further, it was suggested that an advisory group be formed to establish the appropriate methodological framework of the model system. With regard to data used in any policy analysis model, it was recommended that OTI develop and maintain an integrated system of economic, environmental, and energy accounts that is coordinated with the statistical agencies that collect the data.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 33266, 33267, 33368, 33666, 33683, 33684, 33685, 33686, 33688, 33692, 33693, 33694, 33696, 33697, 33709, 33725, 33726, 33727, 33728, 33761, 33768, 33772, 33776, 33785, 33789, 33817, 33818, 34113, 34440

33667 (CONF-800212—) **Energy in the '80s: decade of decision.** (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 90p. NTIS, PC A05/MF A01.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

This proceeding includes the six papers presented at the Public Awareness Symposium plus the WATTEC/Engineers' Week banquet address on nuclear power by Dr. Harold M. Agnew of General Atomic Co.; these presentations on the final day, February 22, concluded the 1980 WATTEC conference. A separate abstract was prepared for each paper and for the banquet address.

33668 (CONF-800212—, pp 23-33) **Alternating energy currents.** Keating, B.A. (Consumer Alert, Inc., New York, NY). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Ms. Keating observes that irrational fears and public perceptions fed by those who call themselves consumer advocates and environmentalists shape the politics of energy. Further, she notes that the demand for a risk-free world by the anti-technologists has reversed public support for nuclear energy and the free-market system and made the Federal government a prime energy waster. She finds the most active of the no-growth advocates in a position to demand that most of the sacrifice be made by those most in need. However, she feels that a loud response by productive consumers could put the utopians on the defensive, make regulations more sensible, and promote responsible research into the problem of risks. A plan for fighting back must recognize that any energy system that works will be rejected by the utopians. Ms. Keating suggests that the best course of action is for productive consumers and pro-energy groups to seek out the facts about energy and dramatize and articulate them for the public - that there are ample opportunities to get off the defensive and take the initiative.

33669 (CONF-800212—, pp 35-43) **Sociological implications of an energy-deficient society.** Clemente, F. (Pennsylvania State Univ., University Park). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Dr. Clemente identifies many of the socio-economic consequences of not building sufficient generating capacity, confirming the significance of electric power to our social structure. The impact of power outages on health, safety, and the economy is intensified for those with lower incomes. The effects on communications, emergency responses, business, agriculture, crime, and every facet of modern life can be life-threatening in the short term and devastating in the long term. None of the fourteen indicators of the quality of life were found to improve during an outage, while six deteriorated and four more were likely to deteriorate. These findings need to be incorporated into regulatory considerations. (DCK)

33670 (CONF-800212—, pp 45-52) **Politics of energy.** O'Keefe, B.J. (EG and G, Inc., Boston, MA). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Energy's share of the US gross national product has grown from 5 to 12% in a few years, giving any effective policy adjustments a magnitude which the public is not ready to accept. A transfer of wealth has occurred domestically as well as internationally and has led to policy shifts to price control and then to decontrol. The Windfall Profits Tax, which taxes production rather than profits, is designed to handle the domestic transfer. Mr. O'Keefe sees a combination of coal and nuclear power and conservation as the only ways to combat the balance-of-payments deficit and lower our dependence on imports. He feels that political questions must address how public money is to be divided among new energy technologies and how to allocate funds to those unable to pay high energy bills. Policies are needed, he says, which relieve government regulation and restore the capital and risk-taking incentives that will improve productivity and stop inflation. The public must accept the fact that we are a poorer nation than we used to be. (DCK)

33671 (DOE/CS/20258—2, pp 86p, Paper 1) **Generation of the industry/occupation wage matrix and related matters. Final report.** Green, C. Jan 1980.

In Labor and energy impacts of energy-conservation measures.

This describes creation of the industry/occupation wage matrix. This is a matrix 40 Occupation x 90 I-O sectors listing 1978 yearly earnings in $1978 for full-time equivalents. Some summary data are: mean ($10,964); standard deviation ($4,150); and median ($10,200). These are 1978 salaries expressed in 1978 dollars. As stated the wage data are for 1978, which was the most recent available. The occupation-industry structure is from 1972, because this data (generated by Lawrence Berkeley Labs.) was the best available for the needs. Also, the (normalized) occupation-industry matrix was calculated by dividing each entry by the gross domestic output for that industry in 1972, but expressed in 1967 dollars. Thus the units are full-time equivalents/unit of output in 1972. For energy sectors, the units are Btu. For non-energy sectors, the units are $1967.

33672 (DOE/EI/10553—T1) **Energy taxation: an analysis of selected taxes.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 1980. Contract AC01-79EI10553. 108p. NTIS, PC A06/MF A01.

Taxation is a key instrument by which governments affect economic decision making and outcomes. Not surprisingly, energy taxation has received considerable attention in recent years with the mounting concern over national energy policy. As with other policy instruments, the taxation of energy production and use spans a wide array of topics. It also cuts across other instruments because it affects the entire spectrum of economic variables - prices, outputs, investments, uses, and so on. As a result, the subject of energy taxation constitutes a highly complex set of issues for public policy. This report examines the principal components of that set of issues. In the process, it points out the most-important interrelations among the various taxes and between taxation and other policy instruments.

33673 (LBL—11349) **Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory.** Schroeder, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01.

In an effort to assist SESA analysts and CETA prime sponsor planners in the development of labor-market information suitable to their annual plans, the Labor Market Projections Model (LMPM) was initiated. The purpose of LMPM is to provide timely information on the demographic characteristics of local populations, labor supply, and unemployment. In particular, the model produces short-term projections of the distributions of population, labor force, and unemployment by age, sex, and race. LMPM was designed to carry out these projections at various geographic levels - counties, prime-sponsor areas, SMSAs, and states. While LMPM can project population distributions for areas without user input, the labor force and unemployment projections rely upon inputs from analysts or planners familiar with the economy of the area of interest. Thus, LMPM utilizes input from the SESA analysts. This User's Guide to LMPM was specifically written as an aid to SESA analysts and other users in improving their understanding of LMPM. The basic method of LMPM is a demographic cohort aging model that relies upon 1970 Census data. LMPM integrates data from several sources in order to produce current projections from the 1970 baseline for all the local areas of the nation. This User's Guide documents the procedures, data, and output of LMPM. 11 references.

33674 (LBL—11350) **Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory.** Kwok, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01.

The Labor Market Projection Model (LMPM) was started in the summer of 1975 to provide local CETA planners with current local estimates of persons in need of manpower services. The geographic levels of LMPM include states, SMSAs', prime sponsors and other special jurisdictions. During the course of project development, two independent efforts have been undertaken at LBL. The first effort produces short-term projections of population, labor force, and unemployment by sex, race, and age for each area. The

population projection is based on a refined cohort-component method and integrates data on mortality, fertility, and net migration. Submodels are developed to handle the military and college-student populations. The second effort updates selected socio-economic characteristics available at the local level in certain tabulations of the 1970 Fourth Count Census by using data from the March Current Population Survey (CPS) for 1970 and the current year. The actual updating is done using proportions based upon current year and 1970 CPS values for the selected socio-economic characteristics. The updating methodology is detailed in Section 2. Future directions of the updating procedure is presented in Section 3.

33675 (SAND—80-1871C) **Political side of risk: a new approach.** Sorenson, J.B.; Trauth, C.A. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 26p. (CONF-800845—1). NTIS, PC A03/MF A01.

From Annual meeting of the American Political Science Association; Washington, DC, USA (28 Aug 1980).

The resolution of many of the Nation's most-serious problems today is hampered by our apparent inability to systematically deal with the socio-political dimensions of the societal acceptance of risks in areas of technical development, decision making, and policy formulation. Nowhere is this more apparent than in the energy field. The nature of public hazards has changed drastically during the past half century or so, driving public considerations of risk into the political realm. This has given many of the socio-political parameters underlying individual, group, and institutional perception and acceptance of risk an importance not typically recognized in technical approaches to risk assessment. As a result, there is now a large gap between technically based views of risk and societal views of risk which, the authors feel, is largely responsible for impeding the resolution of the national problems alluded to above. This paper proposes a general approach toward closing this gap, by using indicators from the political system to measure public perceptions and acceptance of risk, as a continuing function of time, to provide the technical community and policy and decision makers a basis from which to more effectively meet societal environmental, safety, and health goals. 15 references, 6 figures.

33676 **Our energy horizons: a missing perspective.** Maxey, M.N. (South Carolina Energy Research Inst., Columbia). pp 44-48 of Proceedings of the fifty-ninth annual convention. Tulsa, OK; Gas Processors Association (1980).

From 59. annual convention of the Gas Processors Association; Houston, TX, USA (17 May 1980).

Many pessimists view the current political struggle over energy technologies not simply as a matter of managing alternative risks and benefits, but rather as a matter of survival or extinction of Spaceship Earth. They would replace our hard energy technology with soft, appropriate technologies that use renewable resources. The assumptions underlying such attitudes are examined. The good old days were not so safe, and the quality of life is lower in the developing rather than the developed countries. Renewable resources are being better utilized in industrialized-technological societies. As Rene Dubos has observed, there are no natural resources in the world; all are raw materials transformed by man. As for the social injustice-inequity issue, research by the Meinels has shown that social inequities (gap between rich and poor) are greatest in the less-developed countries having low per-capita energy use. Some of the claims made for solar power are either false or contradictory, e.g., it is cheap and also creates jobs. While energy conservation is a laudable program for the affluent and the middle class, no such clamoring for doing without energy is heard from Blacks or other minorities. The only way to stabilize population and domestic unrest throughout the world is to achieve moderate levels of material well being, prosperity, and health for all. Reliable energy supplies ae essential to that well being. (DLC)

33677 **Energy use and human life styles.** Crossley, D.J. Brisbane, Australia; Griffith University (1979). 169p. (NP—25080).

The activities which can be carried out in a society, and therefore the life styles which can be adopted, are a result of the magnitude of energy use and the characteristics of the energy systems used in that society. The magnitude of energy use determines the levels of activities, and the characteristics of the systems used determine the range (number and type) of activities that can be carried out. The relationship between energy use and energy systems and the social organization of a society is immensely complex, but it is probably true to say that energy use and energy systems influence the social structure which develops in a society rather than vice versa. This influence is exerted through the effects of energy use and energy systems on human activities. Increasing magnitude of energy use and variety of energy systems used has both removed and imposed constraints on the life styles that can be adopted in human societies. Constraints of life styles were removed at the societal level by the effects of increasing energy in enabling the progressive differentiation of life styles in historical human societies. However, increasing energy has imposed constraints on life styles in more recent human societies: at the societal level through detrimental effects on human health and well-being, and at the level of the individual through facilitating the exploitation of the mass of people by a small elite - an exploitation which has become institutionalized in contemporary societies.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 33666, 33738, 33778, 33801, 34118, 34119, 34131, 34140, 34162, 34163, 34166

33678 (CONF-800212—, pp 5-21) **Daily risks of life.** Wilson, R. (Harvard Univ., Cambridge, MA). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

The risks that the average individual confronts during a routine day and the health and life expectancy improvements which accompanied the technological age are examined. A comparison of the risks associated with conventional energy systems as well as those of renewable energy, conservation, and nuclear war, concludes that nuclear power is preferable to coal. A cautionary note suggests, however, that it is wise to continually reduce technological risks even when the benefits are high. (DCK)

33679 (ORNL/TM—7186) **Terrestrial perturbation experiments as an environmental assessment tool.** Suter, G.W. II. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01.

The National Environmental Policy Act of 1969 (NEPA) was initially interpreted as requiring full disclosure of the environmental impacts of a federal action. Because of the limitations of time, money, and manpower, this requirement that all impacts be considered has led to superficial analysis of many important impacts. The President's Council on Environmental Quality (CEQ) has provided a solution to this problem by reinterpreting NEPA as requiring analysis of those impacts which have significant bearing on decision making. Because assessment resources can now be concentrated on a few critical issues, it should be possible to perform field perturbation experiments to provide direct evidence of the effects of a specific mixture of pollutants or physical disturbances on the specific receiving ecosystem. Techniques are described for field simulation of gaseous and particulate air pollution, soil pollutants, disturbance of the earth's surface, and disturbance of wildlife. These techniques are discussed in terms of their realism, cost, and the restrictions which they place on the measurement of ecological parameters.

33680 (UCB/ERG—80-1) **Environmental aspects of renewable energy sources.** Holdren, J.P.; Morris, G.; Mintzer, I. (California Univ., Berkeley (USA). Energy and Resources Group). Feb 1980. Contract W-7405-ENG-48. 102p. NTIS, PC A06/MF A01.

The literature treating environmental characteristics of renewable energy sources is surveyed and reviewed. The information required for comprehensive, comparative assessment of the environmental effects of energy alternatives is determined, and the coverage of the extent literature is evaluated against this standard. The technical characteristics of relevant energy technologies are summarized, emphasizing environmental aspects. The most promising revewables are compared to each other and to nonrenewable energy technologies. Suggestions concerning implications for energy choices are made. (ACR)

33681 (UCRL—84839) **Public reaction to imposed risk.** O'Banion, K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 15 Aug 1980. Contract W-7405-ENG-48. 14p. (CONF-800849—1). NTIS, PC A02/MF A01.

From US environmental protection agency workshop on environmental risk assessment of synfuels; Alexandria, VA, USA (25 Aug 1980).

Implicit in every nonarbitrary government decision on the use of technology is a trade-off of a certain amount of risk in return for societal benefits. However, the assessment of this risk is often frustrated, not only by inadequate experience and by incomplete knowledge of the causality of environmental impacts, but also by a disparity between individual and societal views of risk. While the societal view is based on quantitative methods and objective risk functions, and on net societal benefit, individuals tend to rely on subjective judgment, and consider the distribution as well as the amount of benefit. The resultant biases in the way individuals perceive risk are key to the viability of any policy decision, and thus must be considered in determining the future course of research in risk assessment.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 33700, 33814, 34159, 34160

33682 Directory of Washington mining operations, 1979. McFarland, C.R.; McLucas, G.B.; Rigby, J.R.; Stoffel, K.L. Olympia, WA; Washington Division of Geology and Earth Resources (1980). 101p. (NP—25085).

Mining operations in Washington that were active in 1979 are arranged in three categories: those producing and those preparing to produce metallic minerals; those producing nonmetallic minerals, except for sand and gravel; and those producing sand and gravel. In the text of the directory the operations are listed alphabetically by organization name under each of three categories. Each entry, in addition to the organization name, includes the names of officers or owners, a mailing address, plant capacity or production if available, the current status of activity, the product or products, and the location of the producing property by county, nearest city or town or other geographic feature, and legal land description. Following the text (alphabetical listings) are three sets of indexes. The first set is PROPERTY INDEXES for metallic and nonmetallic properties. If the name of the mine, prospect, claim, pit, or quarry is known, these indexes provide direction to the full listing in the alphabetical or text section. The second set is PRODUCT INDEXES for metallic and nonmetallic products. If information on producers of a certain mineral product is desired, these indexes identify those producers in the alphabetical section. The third index, the COUNTY INDEX, lists all active mining operations that are located in each county. This index includes the product or products of each metallic or nonmetallic operation and the nearest town or city for each sand and gravel operation.

33683 Minerals in the economy of Missouri. Dressel, W.M.; Martin, J.A. Pittsburgh, PA; Bureau of Mines (1979). 23p. (NP—25073).

Nationally, Missouri ranks in the top 10 among the 50 States in nonfuel-mineral production; it leads the Nation in the production of lead and refractory clays and ranks second in barite and zinc, third in lime, fourth in stone, and fifth in cement. With the exception of iron ore and zinc production, the Missouri mineral industry was generally in fair to good condition during 1978. The value of nonfuel mineral production, $857 million, was 3% over that of 1977, and for the 17th consecutive year, the total value was an all-time high. Significant value increases were noted for barite, cement, lead, lime, and stone; moderate increases were noted in clay, sand and gravel, and silver values. Copper production value declined slightly with substantial declines being shown in zinc and iron value. Lead was the leading mineral commodity in terms of revenue (40% of the State's total value), followed by cement, stone, lime, zinc, sand and gravel, iron ore clays, copper, and silver. Largest tonnages of marketable minerals were for stone, sand and gravel, and cement. The value of the nonfuel-mineral production in Missouri was approximately $180 per capita; the value per square mile amounted to $12,400.

33684 Minerals in the economy of Wyoming. Koch, C.A.; Miller, D.N. Jr. Cheyenne, WY; Bureau of Mines (1979). 19p. (NP—25072). Bureau of Mines, Pittsburgh, PA.

Since 1970, Wyoming has experienced a very rapid development of its vast mineral deposits. Minerals leading the way in development have been coal, uranium, oil, gas, and trona. In 1978, value of mineral production rose to a record $2.6 billion (using State sources for fuel data). The State is the Nation's leading producer of natural sodium carbonate and bentonite, second in uranium production, fourth in coal production, fifth in oil and iron ore production, and seventh in gas production. 1978 was another record year for the value of production, which was about $2.6 billion, based on an estimated production of 60 million tons of coal valued at $450 million, 340 billion cubic feet of gas valued at $278 million, 10.3 million barrels of liquefied petroleum (LP) gases and cycle products valued at $67.1 million, and 136.4 million barrels of petroleum valued at $1.1 billion. The output of Wyoming's coal industry increased 36%, from 44 million tons in 1977 to an estimated 60 million tons in 1978. Wyming has moved into fourth place, ahead of Illinois, in the national standings for coal production, according to State data.

33685 Minerals in the economy of Utah. McKinney, W.A.; Stowe, C.H. Salt Lake City, UT; Bureau of Mines (1979). 19p. (NP—25076). Bureau of Mines, Pittsburgh, PA.

In 1978, Utah ranked 12th in the United States in total value of nonfuel-mineral production. The leading metal and nonmetal commodities, in order, are copper, gold, uranium, molybdenum, portland cement, and potassium salts. The largest single copper-mining operation in the US, also producing gold, silver, molybdenum, and selenium as byproducts, is located in Utah. Copper accounted for about 46% of the total nonfuel-mineral production value in 1978. The value of mineral production excluding mineral fuels in Utah for 1978 was about $595 million, an increase of 10% over that reported in 1977. The Utah Geological Mineral Survey provided estimates of 1977 coal production and value, and the 1978 production and value of all the mineral fuels. Based on these estimates, the total value of nonfuel and fuel mineral production in Utah for 1978 was about $1.22 billion. Twelve metal commodities and 15 nonmetals or industrial minerals were produced. Metals, principally copper, accounted for 38% and nonmetals accounted for 11% of the total value of mineral production in the State. Mineral fuels accounted for 51% of Utah's production value. Total production value of metals was $465 million, a 10% increase over 1977. Six commodities in this group had greater production values in 1978. Commodities registering substantial gains were molybdenum, gold, and vanadium. Cement, potassium salts, sand and gravel, and salt were the leading commodities in value among the nonmetals group. The total nonmetals value increased 11% above 1977 to slightly over $130 million. Ten commodities increased in value and sodium sulfate, gypsum, magnesium compounds, and lime declined.

33686 Minerals in the economy of Illinois. Glover, T.O.; Bradbury, J.C. Springfield, IL; Bureau of Mines (1979). 16p. (NP—25077). Bureau of Mines, Pittsburgh, PA.

In 1977, the value of mineral production in Illinois was more than 50% of the value ($3.197 billion) of agricultural production. Coal is the leading mineral commodity in terms of value; oil ranks second. Stone and sand and gravel, which are used largely in construction, rank third and fourth, respectively, and fluorspar is fifth. The value of minerals produced in Illinois in 1978 decreased compared with the 1977 value, owing chiefly to a substantially lower output of coal, although oil and gas production also dropped about 8%. Fluorspar also showed a decrease of 14% in production. Two other major mineral commodities - stone and sand and gravel - showed increased production. In 1978, Illinois remained the leading producer of fluorspar and tripoli and ranked among the leading five States in the production of stone and peat. Barite, zinc, lead, stone, and silver are recovered as byproducts of fluorspar mining in the southeastern part of the State. Illinois is one of the Nation's leading steel-producing States, ranking fourth in 1977 and probably the same in 1978. In 1977, Illinois mills produced almost 11 million tons of raw steel, which represented nearly 9% of US output. A similar level of output was produced in 1978. Over the past 5 years, Illinois has maintained its position as producer of 8 to 9% of US total raw steel output.

33687 Resources for an uncertain future. Hitch, C.J. (ed.). Baltimore, MD; Johns Hopkins University Press (1978). 117p. (CONF-7710235—). Resources for the Future, Inc., Washington, DC.

From Forum marking the 25th anniversary of the founding of Resources for the Future; Washington, DC, USA (13 Oct 1977).

Papers presented at the forum marking the 25th anniversary of the founding of Resources for the Future are included. The purpose of the forum was to appraise the resource and environmental outlook for the United States during the next 25 years. Informed opinions on selected issues are offered. Topics covered are: resource in the past and for the future; resources and environment in the next quarter century; energy imperatives and the environment, coping with an uncertain future; and, environment and the economy. (DC)

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 34219

33688 (CONF-800212—, pp 53-58) **Technology: today's blue chip.** Faulkner, R. (Salt River Project, Phoenix, AZ). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Ms. Faulkner feels that the development and current activities of the antitechnology movement are heading the US toward a position of technological depletion. She cites six dogmas that underlie the belief that technology is dehumanizing and is separating man from his natural environment. These dogmas are examined and found to have little basis in fact. Technology is one expression of man's will; its products are the results of his choices. Ms. Faulkner suggests strongly that supporters of technology speak out to encourage public participation in energy decisions, to rebut the horror stories, to promote the study of science, and to remind the users of technology of the benefits they enjoy. (DCK)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 33311, 33314, 34136

33689 (CONF-800212—, pp 73-82) **Nuclear power: in perspective.** Agnew, H.M. (General Atomic Co., San Diego, CA). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Dr. Agnew, former director of Los Alamos Scientific Lab., observes that modern communications have made the over-populated and less-developed countries impatient to have the energy-intensive living standards enjoyed by Europe and the US. More cartels can be expected, he feels, to give these people economic leverage unless they are supplied with cheap, available energy. He notes that all energy sources, including nuclear, have a role and must be developed. The economic and environmental impacts of nuclear energy compare favorably with other major energy sources, but the public neds to be given factual rather than sensational information about nuclear energy so that realistic comparisons can be made. Dr. Agnew points to new types of reactors for land-based facilities that can be designed and that will be safer than the water-cooled design and eliminate some risks. He also finds fuel reprocessing removing some risks, in contrast to the failing nonproliferation policy. He admonishes opponents of nuclear energy to recognize that their position has serious social and economic implications for developing countries and possibly grave political and security repercussions for the US. (DCK)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 33234, 33759, 33835

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 33758, 33797, 33801, 33803, 33804, 33805, 33806, 33807, 33808, 33809, 33810, 33811, 33812, 33813, 34062

CONSERVATION

REFER ALSO TO CITATION(S) 33481, 33671, 33699, 33712, 33768, 33769, 33772, 33774, 33781, 33782, 33784, 33785, 33786, 33793, 33800, 33834

33690 (BNL—51046) **Ranking energy-conservation measures to establish research priorities: synopsis of a workshop.** Moskowitz, P.D.; Le, T.Q.; Pierce, B. (Brookhaven National Lab., Upton, NY (USA)). 2 May 1979. Contract AC02-76CH00016. 112p. NTIS, PC A06/MF A01.

A workshop was convened to assist DOE's Technology Assessment Division in evaluating the need to prepare additional environmental- and social-impact assessments of different energy-conservation measures. Attendees participated in a decision-making exercise designed to rank 19 different energy-conservation measures according to their overall potential for achieving important national goals and their ease of implementation. The participants felt that the most-important ranking criteria dealt with questions concerning feasibility (economic, political/institutional, social, and technical) and economic efficiency. Other criteria, such as environmental quality and occupational health and safety received lower weights; possibly because of the widespread belief that most of the conservation measures presented would be environmentally beneficial. In the participants' view, the most-promising and feasible conservation measures include new-building-performance standards, retrofit of existing housing stock, new-appliance-performance standards and increased use of smaller cars. In contrast, conservation options which ranked rather low, such as diesel engines, coal-fired aluminum remelt furnaces, and cupola furnace modifications were expected to have some harmful environmental and health impacts. Most of these impacts are expected to be highly localized and of lesser national concern. Disagreement exists as to the efficacy of funding those projects deemed highly desirable and feasible versus those which are expected to have the greater environmental and social impacts. These differences must be taken into account in the research priorities that are eventually established. While environmental and social impacts of alternative energy-conservation measures may prove to be either harmful or beneficial, neither side should be ignored by the policy maker.

33691 (CUERS-Report—8) **Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995.** Wallace, N.D.; Kahn, A. (Southern Illinois Univ., Edwardsville (USA). Center for Urban and Environmental Research and Services). Nov 1978. 35p. Southern Illinois University, Edwardsville, IL.

The results of two studies are presented in this monograph. The research in Chapter One, Land-Use Patterns and Their Effect on Energy Consumption for the St. Louis SMSA, Projections for 1995, is based on a land use/energy model which uses an actual regional land-use plan and local energy data. The results of the model, projected for five alternative residential-growth patterns in 1995, indicate that although energy consumed by residential units does not vary significantly with shifts in residential housing, transportation energy consumption is substantially affected. Chapter Two, Energy-Conservation Potential of Alternative Transportation Strategies for the St. Louis SMSA, further examines transportation strategies. Results indicate that these strategies can save worthwhile amounts of energy, and that increased carpooling is the most effective of the strategies considered. 24 references.

33692 (DOE/CS/20258—2, pp 44p, Paper 3) **Energy and labor implication of improving thermal integrity of new houses. Final report.** Nangle, J.J. May 1980.

In Labor and energy impacts of energy-conservation measures.

The net energy savings of a program to improve the thermal integrity of new single-family detached homes from 1980 through 2000 are calculated. Also calculated are the total-labor requirements for each year and the associated occupations and salaries for every fifth year. In the year 2000, a net energy saving of 0.781 quadrillion Btu is expected, along with a gain of 97,000 jobs.

33693 (DOE/CS/20258—2, pp 24p, Paper 2) **Job shifts from energy conservation: salary distribution effects. Final report.** Herendeen, R.A. Apr 1980.

In Labor and energy impacts of energy-conservation measures.

The labor-energy debate has advanced to the point where more-detailed aspects of jobs are required. Employment-impact results of an energy-conservation program are presented in several ways to illustrate these aspects, particularly salary distribution. This particular program (producing thermally tighter single-family residences) does save energy and produce jobs (30,000 jobs produced, 0.5 quads saved in 1990). The effects would include a lowering of average salary, an increase in total personal income, and a narrowing of the national average-salary distribution.

33694 (DOE/CS/20258—2) **Labor and energy impacts of energy-conservation measures.** (Illinois Univ., Urbana (USA). Office of Vice Chancellor for Research). 1980. Contract AC02-79CS20258. 159p. NTIS, PC A04/MF A01.

Three papers are presented discussing the labor and energy impacts of energy-conservation measures, namely: Generation of the Industry/Occupation Wage Matrix and Related Matters, by Carole Green; Job Shifts from Energy Conservation (Salary Distribution Effects), by Robert A. Herendeen; and Energy and Labor Implication of Improving Thermal Integrity of New Houses, by John Joseph Nangle. A separate abstract was prepared for each paper.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 33265, 33311, 33369, 33370, 33371, 33372, 33373, 33374, 33669, 33713, 33714, 33715, 33716, 33717, 33718, 33719, 33720, 33721, 33722, 33723, 33724, 33743, 33761, 33775, 34113

33695 (CONF-800212—, pp 59-71) **Energy policy: do's and don'ts for the '80s.** Landsberg, H.H. (Resources for the Future, Inc., Washington, DC). Jun 1980.

From 7. WATTec annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Mr. Landsberg feels that the short run, the decade of the '80s, is more fearful than the next century when the energy problems will have been worked out. The short-term problems since 1973 have been the possibility of oil-supply disruptions and the need to find ways to avoid disruptions and to lessen their effects if they occur. Long-term problems of rising energy costs and the substitution of new energy sources call for supply and demand adjustments that minimize socio-economic impacts. Mr. Landsberg outlines some do's and don'ts. For example, we do need: (1) to provide people with enough technical and economic information to make appropriate choices; (2) to regulate in certain cases; (3) to provide conservation subsidies and oil disincentives; (4) to explore the energy-efficiency potential in every sector; and (5) to motivate energy users to conserve. We don't need to go back to price controls, subsidize all energy-saving ideas, or expect immediate results just because an idea is technically feasible. Four ways are outlined for finding new liquid fuel: more exploration, faster recovery, enhanced recovery, and synfuel development. Mr. Landsberg suggests that we must also modify environmental policy and develop better technologies to use coal and nuclear fuels. (DCK)

33696 (DOE/EIA—0173(79)3) **Annual report to Congress, 1979. Volume 3. Projections.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 371p. NTIS, PC A16/MF A01.

This volume of the Energy Information Administration (EIA) Annual Report to Congress presents projections of energy produc-

tion, consumption, and prices. An analysis of the world oil market provides the basis for three separate assumptions about how the price of internationally traded oil may evolve. Projections are provided for both world and domestic energy markets, based on the three assumed oil price paths. Estimates of world energy production and consumption are provided for 1985, 1990, and 1995. Separate domestic projections are given for three time frames: the short term (1980 and 1981), the midterm (1985, 1990, and 1995), and the long term (2000, 2010, and 2020). The sensitivity of the projections to key assumptions also is investigated.

33697 (DOE/EIA—0181/2) **Feasibility of financing domestic energy development during 1978-1984. Analysis report AR/EI/79-26.** Kanhouwa, S.P. (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1979. 127p. NTIS, PC A07/MF A01.

This report is an elaboration and an extension of the Section on Finance presented in Chapter 3 of the 1977 Annual Report to the Congress by the EIA. It introduces the satisfactory financing of energy as yet another factor likely to significantly affect the sensitivity of alternative energy-supply projections shown in the ARC. It assesses whether the growth of private investment demand in energy - as implied by the projections - can be adequately met in the future. Aggregate estimates of energy capital requirements are derived for the period from 1978 to 1984. This is done by taking into account capacity additions and levels of exploration and development activity necessary to attain alternative levels of domestic energy output. The latter are abstracted from Projection Series A (high-supply, high-demand), Projection Series C (mid-supply, mid-demand), and Projection Series E (low-supply, low-demand). These correspond to high, medium, and low capital requirements, respectively. In Section II an historical overview of energy investment is presented for the period 1960-1977. In Section III estimates of the capital requirements necessary to achieve the output levels of Projection Series A, C, and E are developed. In Section IV the feasibility of meeting these requirements in the aggregate is analyzed with reference to alternative states of the economy and associated conditions in domestic capital and financial markets. In Section V microeconomic analysis of three major energy-producing sectors, electric utilities, coal, oil, and gas is presented.

33698 **Oregon's energy future. Fourth annual report, January 1, 1980.** Salem, OR; Oregon Department of Energy (1980). 118p. (NP—25092).

The Oregon Department of Energy (ODOE) Fourth Annual Report discusses key energy issues and describes programs and activities designed to implement executive and legislative energy policy. The report opens with an overview of state, regional, and national energy policy developments and major energy-related events of 1979. The two following chapters address the state's role in the development and use of both conventional and renewable energy resources. Chapter Four discusses energy conservation and ODOE activities in that area. Energy forecasts are presented in the fifth chapter. Forecasting methodologies and assumptions are described and comparisons are made between the ODOE forecast and forecasts of energy suppliers. The report concludes with a chapter on electricity supply and demand in the Pacific Northwest region.

33699 (HNEI—80-04) **Energy self-sufficiency for the County of Kauai. Volume 2. General energy plan.** Kai, K.; Browne, S.; Hahn, Y.; Seki, A. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). Jun 1980. 114p. Univ. of Hawaii, Hawaii Natural Energy Inst., Manoa.

Volume 1 of this study presented background information concerning the environment, the economy, past trends in the use of energy, and potentially available natural energy resources of Kauai. In Section II of this volume, Vol. 2, present energy-use patterns are described, updating the data of Volume 1 through 1978. Based upon past trends, three plausible scenarios of future economic growth and the corresponding projections of future energy demand are developed in Section III. Potential sources of energy to meet projected demands are discussed in Section IV, including conservation and indigenous energy resources. The present state of energy technology and its implications for Kauai are reviewed, economic factors and environmental impact issues that will influence selection of sources are discussed and current and planned RD and D programs are described. Section V presents an energy-supply projection to be used in subsequent analysis. It represents a reasonable growth pattern in which sources available immediately and in the near future, conservation, biomass, solar water heating, and wind, are utilized in earlier years, augmented by solar power generation and ocean energy conversion, as they might be expected to become available. The results of analysis of the impact of this supply projection on each projected demand are discussed, including some economic impacts and alternatives that might increase future supply when projected supplies fall short of demand. Some general conclusions are drawn in Section VI.

33700 (PB—80-126956) **Projected annual resource requirements at the national and regional level for the Department of Commerce energy forecast, 1985 and 2000.** (Bechtel National, Inc., San Francisco, CA (USA)). 1980. 230p. NTIS $13.00.

This report describes the resource implications at the national and regional level for a likely energy supply and consumption forecast for 1985 and 2000 by the Department of Commerce. Total energy resource consumption is projected to increase at an average annual rate of 1.8% for the 1977-2000 period. Electric energy consumption is projected to grow at 4.2% per year. US energy consumption, expressed in quadrillion Btu's (quads) is projected at 87 quads in 1985 and 116 quads in the year 2000. Projected energy supply and consumption levels were simulated using Bechtel's Energy Supply Planning Model, which calculated the direct resource requirements for capital, labor, materials and equipment, land and water, and operations and maintenance costs to construct, operate, and maintain energy-related facilities at the national and regional level. Results of the analysis indicate projected cumulative capital requirements of 1.6 trillion January 1978 dollars during the 1977-2000 forecast period.

33701 (PCTR—92-80) **Forecasting higher order statistical moments and probability densities for power system loads by the method of time series.** Farahbakhshian, N. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). May 1980. Contract AS02-77ET29102. 119p. (TR-EE—80-18). NTIS, PC A06/MF A01. Thesis.

Demand forecasting of electric power system loads has been conventionally done by prediction of the expected value of the demand. This mean value being subject to uncertainty does not fully characterize the quantity demanded since a stochastic process is not fully characterized by its expected value. In this thesis, not only the mean value but also the probability density function of power system loads are obtained. In achieving this goal the method of time series is used to predict the mean value and consequently the higher statistical moments. The latter is then used in a Gram-Charlier series to obtain the probability density function of the electrical power system loads. From this density function a wide variety of quantities may be calculated, namely, the mean value, the probability of the load exceeding some threshold, conditional probabilities, conditional expectation, and a figure of confidence of the forecasted mean. An example is given in which data from an actual electrical load are used.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 33225, 33273, 33274, 33286, 33598, 33667, 33668, 33695, 33698

33702 **Procedures for permit to drill for oil and gas in the Commonwealth of Virginia.** Big Stone Gap, VA; Virginia Department of Labor and Industry (1980). 8p. (NP—25094).

Application for permit to drill for oil and gas in the State of Virginia consists of a written application and operations plans. Guidelines as to what should be included in the operation plans are given in detail. Besides a narrative report describing such items as project area, purposes, schedule of major construction activities and application of conservation practices, a map of the area is required.

33703 **Energy policy in Australia: the social/institutional context and procedures for policy formulation.** Crossley, D.J. Brisbane, Australia; Griffith University (1980). 123p. (NP—25079).

The 1973/74 energy crisis had two main effects on energy policy formulation. First, it forced the recognition of energy as a unitary concept. Previous to the crisis, government energy policy had been concerned with the individual forms of energy, so that separate strategies were formulated for coal, oil, gas, etc. The second effect of the energy crisis was to achieve the speedy acknowledgement in government energy policy of a development in thinking about the role of energy in human affiars which first began to appear in the 1950's. The institutional context in which energy policy formulation takes place and the actual procedures for policy formulation are described. These have both contributed to a narrow, highly technical approach being taken by governments in Australia towards energy matters. The effect this approach has had on energy-policy proposals is examined, and ways are suggested in which the approach may be broadened.

33704 **Review and assessment of the National Energy Act: a Missouri perspective.** Jefferson City, MO; Missouri Department of Natural Resources (1978). 141p. (NP—25037).

The National Energy Act (NEA) was introduced in Congress on April 20, 1977, and signed into law by President Carter on November 9, 1978. This document records the attempt of the Missouri Department of Natural Resources, Energy Program to review and evaluate the impact of the five separate bills which comprise NEA.

33705 Oil ang gas: general rules and regulations. Big Stone Gap, VA; Virginia Department of Labor and Industry (1978). 27p. (NP—25093).

Sixty-two rules and regulations on gas and oil cover items such as: drilling permits, location and access to wells, surface mining, stratigraphic and core tests, disposal and service of wells, underground gas storage, surface equipment of wells, oil measurements, production tests, oil and gas transportation, gas-oil ratio, pipeline connection, and drilling and production violations.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 33171, 33233

COAL

REFER ALSO TO CITATION(S) 33176, 33229, 33230, 33232, 33234, 33241, 34119

33706 (EPRI-EA—1477) Labor outlook for the bituminous coal mining industry. Final report. Wool, H.; Ostbo, J.B. (Conference Board, New York (USA)). Aug 1980. 311p. NTIS, PC A14/MF A01.

This study assesses the extent to which labor supply may be a constraining factor in expansion of US coal output, both in the mid-range period to 1990 and in the longer-term to 2030. Major study components include regional projections of coal industry labor requirements, labor supply, and unit labor costs to 1990, as well as illustrative projections of longer-term demand and supply factors. A combination of econometric and demographic methods are used, supplemented by reliance upon informed judgment for assessing key institutional and labor relations variables. The study concludes that labor supply should not be a significant constraint in the projected growth of coal output in the coming decade, in view of the industry's high wage structure and of a projected gradual improvement in overall productivity. Unit labor costs are expected to grow moderately, at a projected annual rate of about 1 percent, between 1977 and 1990, in constant dollars. Labor supply constraints, however, are considered to be more probable in the longer-term period to the year 2030 if coal demand grows to nearly 5 billion tons annually by the latter, year, as suggested by some recent long-term energy projections. The expected slowdown in US population growth and accompanying trends to an older and less mobile labor force are seen as leading to more rapid escalation of labor costs, unless offset by increased reliance upon more capital-intensive mining methods and technologies.

PETROLEUM

REFER ALSO TO CITATION(S) 33225, 33265, 33266, 33267, 33268, 33273, 33274, 33702, 33705

33707 (NP—25049) Annual report, 1979. (Wirtschaftsverband Erdoel- und Erdgasgewinnung e.V., Hannover (Germany, F.R.)). 1979. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01.

Petroleum and natural gas production and reserves in the Federal Republic of Germany are tabulated. Drilling, geophysical activities, and the activities of German petroleum and natural gas industries abroad are discussed.

NATURAL GAS

REFER ALSO TO CITATION(S) 33267, 33268, 33279, 33286, 33702

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 33352, 33360, 33664, 33787, 33788

33708 (RAND/N—1469-DOE) Values in conflict: design considerations for a two-stage synfuels development strategy. Seidman, D. (RAND Corp., Santa Monica, CA (USA)). Apr 1980. Contract AC01-79PE70078. 38p. NTIS, PC A03/MF A01.

Following President Carter's proposal for a massive crash program of synthetic-fuels development, the Senate approved a more-cautious two-stage development strategy. Some features of the design of a two-stage synfuels development program serving to reduce potential conflict between the values served by synfuels development and other important public values are considered. Section II discusses the potential conflict between synfuels development and values protected or implemented by existing laws and regulations. Section III suggests how the design of the first stage of development might substantially reduce conflict among these values and conflict between synfuels promoters and defenders of other values. It also suggests how first-stage design might help generate information to inform decisions concerning the scope and scale of the second state and facilitate further protection of values in the event of second-stage development. Section IV discusses approaches to avoiding unnecessary damage to competing values in second-stage planning. It considers approaches to site selection that allow accommodation of national interests and the legitimate interests of the states. It suggests how decisions concerning project-specific waiver of regulatory requirements could minimize damage to competing values. The final section presents general conclusions.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 33369, 33669, 33776

33709 (ANL/EES-TM—92) Handbook of five methodologies for the assessment of load management. (Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Feb 1980. Contract W-31-109-ENG-38. 66p. NTIS, PC A04/MF A01.

This report provides a summary description and evaluation of five methodologies that have been developed for the assessment of utility costs and benefits of load-management programs, including marginal-costing methodologies and an integrated set of utility-system planning and production costing models. Of the two basic methods, the first uses marginal-cost data to compute the cumulative reduction in utility-system costs realized in moving units of load from periods of high marginal cost to periods of low marginal cost. The present value of these cost savings may be compared directly with the costs of implementing the load-management program. The second method relies on an evaluation of future total-system costs. System planning and production-costing models are used to calculate the total fixed and variable costs of meeting baseline and alternative-load configurations. The difference between baseline system costs and the costs with load management may then be compared to the costs of implementing the program. The advantages and disadvantages of each method are summarized briefly.

33710 (DOE/CS/20258—3) Structure of the electric utility industry, 1990. Final report. Penner, P.S. (Illinois Univ., Urbana (USA). Office of Vice Chancellor for Research). Apr 1980. Contract AC02-79CS20258. 18p. NTIS, PC A02/MF A01.

A vector of normalized inputs to a hypothetical 1990 electric-utility industry is created. Inputs and outputs from the industry are all considered as homogeneous components of Bureau of Economic Analysis (BEA) economic sectors at approximately the 2-digit (83-sector) level of aggregation. While the sector definitions are BEA-compatible, the vector is created at a 90-sector level of detail for use within the Energy Research Group (ERG) energy input-output model. The vector is listed as ERGELIN. The normalized vector of depreciation capital inputs is stored as ELINDEP. The sum of the two is the final depreciation-corrected vector of 1990 electric-utility industry inputs and is stored as EGELIND. All vectors have units Btu/Btue (1st five sectors) and $1967 per million Btue.

33711 (DOE/EIA—0057/9(79)) Principal electric facilities: Arizona, California, Nevada. (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. NTIS, PC A03/MF A01.

A map is presented of the principal nuclear, fossil, hydro, and exotic electric power plants in Arizona, California, and Nevada. Capacity, type, and location data are tabulated. Information on ownership is included. Transmission line routes are indicated. Detailed maps of the following areas are given: Los Angeles-San Bernardino Area; Sacramento Area; Big Creek Area; Phoenix Area; Las Vegas Hoover Dam Area; and the San Francisco Area.

33712 (P—102-80-004) Commercial status: electrical generation and nongeneration technologies. Khalsa, P.S.; Stamets, L. (California Energy Commission, Sacramento (USA)). Apr 1980. 287p. California Energy Commission, Sacramento.

This report assesses the present status of a broad range of technologies relevant to meeting California's needs for electrical power. The technologies considered include generation and nongeneration options: generation systems are those which produce electricity, such as coal-fired power plants and solar photovoltaic systems; nongeneration technologies can either reduce the demand for electricity, such as energy conservation and solar process heat, or increase the efficiency of existing generation capacity, such as power pooling and reliability measures. The report is a revision of the draft Commercial Status Staff Report released in September 1979. Primary changes in this updated report are revised discussions for coal-derived fuel technologies, repowering, and power-plant availability improvement. Also, it reviews the status of three technologies not discussed in the draft: hot-dry-rock geothermal, solar salt-pond and thermionic conversion. Of technologies covered in these revised or new sections, only repowering of older steam boiler power plants was found to be commercially available. The report reviews the

commercial availability of 47 generation and 15 nongeneration technologies. Several significant fuel processing technologies, such as methanol from coal, are included with the generation technologies. Sixteen generation technologies and 12 nongeneration technologies were found to be commercially available. For other technologies, estimates of the earliest possible date of commercial availability were made by assuming currently planned research and development is undertaken and is successful. Deployment issues associated with the various technologies are listed in a summary table.

33713 (P—300-80-007) **Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification.** (Hittman Associates, Inc., Sacramento, CA (USA)). Feb 1980. 50p. (HIT—706). Canifornia Energy Commission, Sacramento.

This is the first of twelve major technical reports under the Commission's contract with Hittman Associates. The contract will lead to the development of a data base on commercial space, and the development of a model to forecast electricity usage and demand. This report presents a preliminary specification of the model to be developed. The model being developed combines econometric and engineering approaches, and consists of five subprograms and an overall executing program. The first subprogram forecasts the stock of commercial space, based on employment data and other economic inputs. It also distinguishes among various types of commercial space, and breaks the commercial space into segments according to fuels for various end uses, such as heating, cooling, etc. The second subprogram uses detailed building-survey data to specify a typical, or characteristic building for each unique type of floorspace considered in the study. The third subprogram calculates monthly electricity usage for the typical buildings specified, using standard engineering techniques, and then scales up the electricity use for each building type according to the amount of space, of that type, in the entire building stock. The fourth subprogram performs a similar function, but produces hourly electricity demands, rather than monthly electricity usage. The fifth, and final subprogram adjusts the energy usage and demand values calculated to simulate the impact of certain economic conditions or policy measures. The report presents a flow chart for each subprogram, and a table of inputs and outputs required for each. The logic, structure, flow, and information transfer of each is described.

33714 (P—300-80-008) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures .** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 75p. (HIT—706-2). California Energy Commission, Sacramento.

A five-part model was developed, and each of the parts requires certain input data sets that the model uses. This report describes briefly how each of the five parts of the model operate and what kind of input data is used in each of the five parts. The report shows how most of the data needed by the model comes from one of the four data sets, and it provides a detailed description of these four data sets. Finally, the report describes a set of computer programs that HAI has assembled and developed to allow the Commission to expand, update, or shorten the data sets. These include statistical programs and data-handling programs. The five portions of the forecasting model are five subprograms called ECON, INGEN, ENER, DEMAND, and BEHAV. ECON calculates forecasts of commercial floorspace using historical and forecast data on income, population, and other variables, and then it determines the type of energy forms used for heating, and cooling in each class of commercial building. INGEN uses data from an in-depth survey of 500 establishments to specify the detailed characteristics of commercial buildings throughout the state. ENER and DEMAND use complex engineering techniques, combined with weather data, and the buildings data from INGEN, to calculate the energy use in the commercial sector. Finally, the BEHAV model modifies the energy and demand calculations to account for changes in the way people behave in using energy.

33715 (P—300-80-009) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 44p. (HIT—706-3). California Energy Commission, Sacramento.

The overall objectives of the project were to (1) develop a model to forecast electricity usage and demand in the commercial sector, and (2) develop a data base to provide input parameters for the model. This report presents the final description of the sampling methodology employed to determine the samples to be used in the preliminary survey. In addition, a discussion of data needs and uses is provided. The five major steps used are: (1) analyze weather data and partition service areas where necessary; (2) reduce and/or collapse SIC codes within partition; (3) perform cluster analysis within SIC groups; (4) determine minimum total sample size; and (5) allocation of samples. Finally, a procedure is presented in the appendix as thoughts on the subject - in the event that suitable SIC code limitations or combinations cannot be achieved.

33716 (P—300-80-010) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 190p. (HIT—706-4). California Energy Commission, Sacramento.

This report presents the final description of the detailed model specification for the three subprograms INGEN, ENER, and DEMAND, which function as follows: (1) INGEN - the input-generating subprogram - using data from the building surveys, it specifies the detailed physical equipment and operational characteristics of the typical building of each building type, for use by the ENER and the DEMAND subprograms; (2) ENER - calculates annual electricity use in the commercial space, using the commercial-stock value from ECON, the building characteristics from INGEN, and exogeneous weather data - the annual electricity use is used by BEHAV; (3) DEMAND - calculates the hourly electricity-demand profiles for the commercial sector, using the commercial stock and fuel shares from ECON, the characteristic building parameters from INGEN, and exogeneous weather inputs. In addition to the three subprograms, an overview of the model as a whole is provided. Review comments received from the Commission staff on the mentioned subprograms are incorporated.

33717 (P—300-80-011) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 45p. (HIT—706-4). California Energy Commission, Sacramento.

This report presents the final description of the detailed model specification for the two subprograms ECON and BEHAV, which function as follows: (1) ECON - forecasts the stock of floor space, and the additions to space; also forecasts the fuel choice for specified end uses, including space heating, space cooling, refrigeration, lighting, domestic hot-water production, and cooking; (2) BEHAV - simulates the response of owners and operators of commercial to economic conditions. In addition to the two subprograms, an overview of the model as a whole is provided.

33718 (P—300-80-012) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume V. Review of secondary data.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 60p. (HIT—706-5). California Energy Commission, Sacramento.

Secondary data sources were reviewed and a summary indicating the content of each source was prepared. The reviewed secondary data were classified in three categories depending on their use. These categories were: (1) calibration of the model; (2) specification of model parameters in cases where it is impossible to derive them from primary data; and (3) definition of primary data needs. In addition to these three, a fourth use was also identified; this was to provide the Commission staff with secondary data for their use in developing an electricity forecast in Spring 1978.

33719 (P—300-80-013) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VI. Establishent characteristics.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 102p. (HIT—706-6). California Energy Commission, Sacramento.

In this report the three surveys performed during this project are discussed. These data bases include the mail survey of utility customers, the detailed on-site establishemnt survey, and the metering survey.

33720 (P—300-80-014) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VII. Detailed survey, sampling methodology.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 35p. (HIT—706-7). California Energy Commission, Sacramento.

This report describes the work performed toward obtaining two sets of primary data, from which econometric and engineering parameters for the model were to be derived. The first type will be collected in a mail survey of utility-company customers determined by an analysis of customer-account data. These data have been collected from Pacific Gas and Electric, Los Angeles Div. of Water and Power, San Diego Gas and Electric, and Sacramento Municipal Utility District (SMUD) and have been analyzed and the survey customers selected. The second type will consist of detailed technical data on buildings in the SMSA's of Los Angeles, San Diego, San Francisco, and Sacramento. This report presents the final methodology for the selection of building samples, by type and location, for the detailed building data collection. Eleven tables present the results of the analysis. Within service areas and/or SMSA's, significant establishment classifications are illustrated with their energy characteristics. The allocation of the detailed survey-sample members is illustrated, according to establishment classifications and the 24 different building types. This specification is further detailed as to allocations within the SMUD service area and those to be taken from other areas. The methodology presented in this final report is being used to select sample members for the detailed survey.

33721 (P—300-80-015) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VIII. Detailed establishment questionnaire.** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 32p. (HIT—706-8). California Energy Commission, Sacramento.

A preliminry version of the detailed establishment-level questionnaire was developed. A description of criteria employed in development and a discussion of such precedes the questionnaire. Finally, the questionnaire is presented.

33722 (P—300-80-016) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IX. Tabulated data collected (computer magnetic tape) .** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 35p. California Energy Commission, Sacramento.

This volume contains the format layout for the tape, as well as encoding conventions used for specific data items. Software for editing and compiling various estimates from the data base is also available. The software is written in PL/1. For more information on the data base, contact the Demand Forecasting Office at the California Energy Commission, 1111 Howe Avenue, Sacramento, CA 95825. Volumes VII and VIII should be acquired in conjunction with this report for a full understanding of the survey project.

33723 (P—300-80-017) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection .** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 33p. (HIT—706-10). California Energy Commission, Sacramento.

The primary-data-collection effort called the Metering Study involves collecting data in the form of demand profiles or instantaneous demand values for buildings and selected electricity end-uses within the buildings. The purposes of collection of metered data may include the analysis of load-management standards, the calculation of usage factors for end-use devices, and possible for future verification of portions of the model as the need arises. Identification of the demand-profile metering sample is based on a method which combines statistical and engineering approaches. The selection is based, in part, on the results of the analysis of commercial accounts performed for the Preliminary Survey sample selection. Combining some results from that analysis with logical engineering constraints, building types are grouped to identify the demand-metering sample. This report presents the methodology used to develop the sample and the methodology for obtaining the desired demand profiles. Chapter II discusses some results of the analysis of the utility-supplied data tapes. Then engineering constraints are developed and applied to the analysis. These together produce a possible list of groups for the demand-metering sample. Chapter III discusses the methods for obtaining the demand profiles for buildings and selected end-use devices.

33724 (P—300-80-018) **Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification .** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1980. 168p. (HIT—706-12). California Energy Commission, Sacramento.

In this report, the estimation of model parameters is presented. These parameters are based on secondary data and a limited review of primary data. During the initial model development, it was decided to postpone work on the BEHAV submodel. Accordingly, this report covers parameters estimated for the ECON, INGEN, ENER, and DEMAND sub-models. The parameters for ECON were estimated using econometric techniques. These are described in Chapter II. The parameters for INGEN, ENER, and DEMAND were developed judgmentally through reviews of existing secondary and primary data on characteristics of commercial buildings. These data and their development are described in Chapter III.

33725 Electric Utility Rate Design Study: the accounting-cost basis for evaluating block rates. Boston, MA; Charles T. Main, Inc. (1980). 51p. (NP—22586). EPRI, Palo Alto, CA.

Block rates for electric service are those in which the per unit price changes with increasing monthly usage. Usage levels are defined by blocks, or successive ranges of monthly consumption. In the most-common form of block rate, the declining block, the per-unit-price decreases with each successive block. The declining block rate traditionally has been used because, according to proponents, it effectively satisfied the need to recover fixed charges early in the rate. Thus, the high initial blocks recovered virtually all the fixed costs and the latter blocks primarily recovered variable costs. Further, the rate was administratively simple and required a minimum of metering equipment. Finally it was also considered advantageous to provide a lower rate to high-volume customers since it was presumed that these loads provided overall benefits to the system. Currently, however, the declining block is undergoing substantial criticism. The three major criticisms are: (1) there exists some question whether the decline in price with increasing use reflects commensurate decreases in utility costs; (2) it is claimed that the declining-block rate structure fosters unnecessary load growth, impeding conservation efforts; and (3) the rate is said to favor large users and discriminate against small users. This paper provides a framework whereby the costs of providing electrical service at differing consumption levels may be calculated. Application of the described methodologies can be used to provide a test of the cost justification of a particular rate form.

33726 Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company. Washington, DC; Ernst and Whinney (1980). 97p. (NP—22587). EPRI, Palo Alto, CA.

This report develops a method for determining average embedded generation costs on a time-of-day basis and describes the application of the method to Iowa Southern Utilities. These costs are not allocated to customer classes. Since average embedded costs are composed of the running (or variable) costs and the capital costs, the analysis examines each of these separately. Running costs on a time-of-day basis are determined through the use of a generation dispatch model that reports the loadings by generating unit and the running costs of meeting the load. These costs are reported on an hour-by-hour basis. The dispatch model takes into account the operating characteristics of each unit and the major engineering constraints on a system; e.g., must-run units, minimum up and down time, startup cost. After reviewing several suggested capital-cost allocation procedures, a method is developed that allocates capital costs on a time-of-day basis by using a recontracting-for-capacity procedure that allows capacity to vary by hour for each month. The method results in allocations to customers who benefit from its use. An important and distinguishing feature of this method is that it allows calculation of the costs before rating periods are chosen.

33727 Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options. New York, NY; Gordian Associates, Inc. (1980). 265p. (NP—22588). EPRI, Palo Alto, CA.

A rigorous procedure is described for conducting a cost/benefit analysis so that an optimal set of load-management options can be selected from a group of potential options. It was developed as part of the additional research on cost/benefit methodology suggested by the progress report of the Electric Utility Rate Design Study (EURDS) to the National Association of Regulatory Utility Commissioners (See NP—22566; EAPA 4:5319). After the first phase of the EURDS, it was determined that a rigorous methodology to evaluate the desirability of load management was needed. The procedure developed is designed to account for the interaction between the load-management options themselves and between these options and supply-management options. Furthermore, the procedure is designed to account for the goals of the utility-planning process and to recognize reliability, dispatch, maintenance, and financial constraints. A separate report containing the comments on the Gordian report (NP—22588) by the EPRI Advisory Group IV is included, but is bound separately.

33728 Electric Utility Rate Design Study: comments on RDS Report No. 66, An Evaluation of Four Marginal Costing Methodologies. Lexington, MA; Temple, Barker and Sloane, Inc. (1980). 185p. (NP—22589). EPRI, Palo Alto, CA.

In July 1979, the Rate Design Study published and distributed a report entitled, An Evaluation of Four-Marginal Costing Methodologies, prepared by Temple, Barker and Sloane, Inc. (TBS). That report, RDS No. 66 (See NP—24255; EAPA 6:1820) summarizes, contrasts, and evaluates four marginal-costing methodologies currently in use by various electric utilities. The proponents of the four methodologies evaluated by TBS were asked to comment on the TBS report (RDS No. 66) to ensure proper representation and to provide the readership with a more comprehensive understanding of the various marginal cost methodologies. Other selected reviewers were also asked to comment on the TBS report. This report, referenced as RDS Report No. 67 (NP—22589) and entitled, Comments on an Evaluation of Four Marginal-Costing Methodologies, is an anthology of all those comments plus a response to them by TBS.

33729 Proceedings of the load-management customer-participation workshop. Sacramento, CA; California Energy Commission (1979). 140p. (CONF-7910178—).

From Load management customer participation workshop; Sacramento, CA, USA (16 Oct 1979).

In 1976, the California Legislature mandated that the California Energy Commission (CEC) should investigate load-management opportunities and recommend standards for California utilities to follow. Load management was seen by the legislature as one potential means of improving the efficiency of existing generating plants, postponing the need for new capacity, and lowering the cost of electric service to the consumer. In May of 1979, four standards were adopted that affect the five major utilities in California. The four standards consist of remote control of residential central air conditioners and electric water heaters; shifting the operating of swimming pool filters to off-peak hours; energy audits of commercial

buildings; and provision for utility rate structures based on a marginal-cost methodology. The CEC sponsored a Customer-Participation Workshop on October 16, 1979 to develop and exchange information on approaches for soliciting and maintaining participation in residential load-control programs. A compilation of the presentations, panel discussion, and question-and-answer session that occurred during the workshop is presented.

33730 Gleneden Beach: PUB final report. Salem, OR; Oregon Department of Energy (1978). 13p. (NP—25091).

Proceedings to annex a parcel of territory in Gleneden Beach to the Central Lincoln People's Utility District are described. The Oregon Department of Energy (ODOE) conducted three public hearings. This report represents the ODOE Director's best judgment on the advisability of annexation after considering the evidence presented at the hearings and gathered in his own investigation. ODOE concluded after studying the issues that firm power is available to the Central Lincoln PUD until 1983 for sale to the Gleneden Beach area, and the residents of Gleneden Beach would benefit from the annexation through lower utility bills. These benefits, along with the small impact on the ratepayers of the Central Lincoln PUD and on Pacific Power and Light Company, make the annexation feasible. Whether the annexation will take place is a political decision reached after an election in the district and the parcel of territory to be annexed. The earliest possible election on the annexation of the territory would be November 1978.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 33367, 33370, 33371, 33372, 33373, 33374, 33375, 33592, 33594, 33595, 33598

33731 (DOE/EIA—0010/3) **Monthly comparisons of peak demands and energy for load, 1974 to 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1979. 23p. NTIS, PC A02/MF A01.

This report summarizes monthly energy and peak load data of the nation's major electric utility systems for a five-year period, 1974 through 1978. The accompanying tables show monthly and annual summaries of net energy for load and peak demand for each of the eight power-supply regions. The statistics indicate that major electric utilities in the contiguous United States produced and sold to their customers 2,175,423.5 gigawatt-hours of electricity in 1978. This represents a 4.0% increase over that supplied in 1977. Compared to 1977, increases in net energy for load in 1978 occurred in each of the eight regions. The greatest increases occurred in the Northwest and West Central regions, which were 7.9 and 7.8%, respectively. The East Central region showed the least percentage increase in net energy for load, 0.6%. The nation's annual growth in net energy for load varied from a high of 6.1% in the 1975-1976 period to a low of 2.0% in the 1974-1975 period. Net energy for load increased at an average annual rate of 4.1% between 194 and 1978. Although growth in the non-coincident summer peak demand for the contiguous United States was only 1.9% in the 1977-1978 period, the average annual growth between 1974 and 1978 was 3.7%. In terms of regional growth for the 1974-1978 period, the Northeast region shows the lowest average annual growth rate (2.4%) in net energy for load; the South Central region shows the greatest average annual growth rate (6.3%) for this period.

33732 (DOE/EIA—0049/78) **Preliminary power production, fuel consumption, and installed capacity data for 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 9 May 1979. 67p. NTIS, PC A04/MF A01.

This Energy Data Report shows statistics for 1978 on electric utility and industrial installed capacity and power production. Also included are consumption and stocks of fossil fuels for electic utilities. The installed generating capacity of the Nation's electric utilities reached a record level of 579,156.9 during 1978, up 3.4% from 560,202.0 MW in 1977. Electric energy production by power plants of industrial establishments was 79.4 million MWh in 1978, a decrease of 9.5% from the 87.7 million MWh produced in 1977. To produce electric energy in 1978, utilities burned 481.7 million tons of coal, 0.9% above the 477.2 million tons consumed in 1977; 635.0 million barrels in 1977; and 3,188.3 billion cubic feet of natural gas, 0.1% below the 3,191.2 billion cubic feet consumed in 1977. In March 1978, coal stocks dropped to a low of 77.2 million tons during the United Mine Workers coal strike and then rose to a level of 129.6 million tons in November. End of year 1978 coal stock levels decreased 3.6 percent below the December 31, 1977 level of 133.3 million tons. Oil stocks reached 139.1 million barrels in July 1978, an increase of 7.8 percent above the July 1977 level.

33733 (DOE/EIA—0049(79)) **Preliminary power production, fuel consumption, and installed capacity data for 1979.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 14 May 1980. 72p. NTIS, PC A04/MF A01.

Electric utility and industrial installed capacity and power production data are reported. Also contained are data on consumption and stocks of fossil fuels for electric utilities. Data are compiled from the Monthly Powerplant Reports filed with the Energy Information Administration. Attention is given primarily to annual statistics, but monthly data are included frequently. The information is aggregated by geographic region and by State, with totals for the United States. Subtotals for energy source and type of prime mover (generating plant) are provided. The narrative analyzes trends and highlights statistics. 10 tables.

33734 (EPRI-AP—1510) **Extension and validation of fault-tree analysis for reliability prediction. Final report.** Land, R.; Rayes, L.; Burns, E.T. (Science Applications, Inc., Palo Alto, CA (USA)). Sep 1980. 121p. NTIS, PC A06/MF A01.

This report presents the reliability projection for a type of fossil-fueled power plant which makes use of a combustion turbine and heat-recovery steam generator in parallel operation with a package boiler. A previous EPRI study (EPRI-AF—811, dated June 1978) demonstrated that a fault-tree reliability model can be used to estimate the reliability of such a plant. The present report makes use of the fault-tree methodology to estimate both the mean plant reliability plus a confidence interval for the calculated reliability prediction. The input component-failure rates, including the error bounds, have been updated from an integrated data base obtained from the best-available data. The estimated reliability results using a model representative of the initial two years of plant operation are compared with the reliability from plant operating experience data for a similar period, and these are presented. The estimated reliability for continuous plant operation for 500 hours is in good agreement with the plant-operating experience. It is concluded that the fault-tree methodology can be applied directly to both the qualitative and quantitative prediction of power-plant reliability. The method is most useful at the design stage of plant development to identify design options or problem areas which can be remedied by: optimizing plant configurations; utilizing redundant power trains; using multiple components to allow partial power operation; and providing an optimum choice of components.

33735 (EPRI-EA—1446) **Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990.** Baughman, M.L.; Kamat, D.P. (Texas Univ., Austin (USA). Center for Energy Studies). Jul 1980. 224p. NTIS, PC A10/MF A01.

Historical planning methods may no longer deal adequately with the long planning horizons and the large number of uncertainties involved in today's electric-power-generation planning. This report's methodology incorporates the use of decision analysis to ensure an explicit consideration of uncertainty in demand growth. Optimal levels of planned capacity for electric-power-generation growth in the nine Reliability Council Regions of the United States are examined for the years 1983, 1988, and 1990. The optimal level is defined to be that level that minimizes the expected cost of power shortages and electricity production. In total, 17 capacity-expansion cases are simulated for each of seven demand-growth possibilities. Estimates for costs of shortages are combined with calculations of the production and incremental-capacity costs for alternative demand and expansion scenarios to obtain estimates for the level of capacity yielding minimum expected total costs. It was found that, for most regions of the country, the optimum plan calculated calls for a more-rapid expansion of generating facilities than that now contemplated.

33736 (LA-UR—80-2354) **Reliability problems in power-generation systems.** Bryson, M.C. (ed.). (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 24p. (CONF-801045—1). NTIS, PC A02/MF A01.

From DOE statistical symposium; Berkeley, CA, USA (29 Oct 1980).

Some widely publicized incidents have called attention to the problems of reliability, safety, and dependability of power-generation systems, increasing public pressure for additional safety guarantees in power systems. The tendency has been to demand guarantees to zero-risk, an attitude which both augments and is augmented by the slow-growth ethic that has become familiar through the 1970s. It is the suggestion of this discussion paper that, regardless of the merits of different political positions on these issues, it is essential to have a more-precise understanding of the factors that are involved: specifically, that mathematical/statistical tools be developed and made available to potential users in order to quantify the magnitude of the risks inherent in using or failing to use competing technologies. The following are discussed: estimation of very-low-failure probabilities; complex-system reliability methodologies; dependence in failure modes; use of observational-study data; communication of reliability data to nontechnical individuals; semi-parametric procedures; estimating the reliability of man-machine systems; degraded-operation failure modes; pooling data; and accelerated data collection.

33737 (P—300-80-001) **Proposed electric power projects.** Sidhar, R.M. (California Energy Commission, Sacramento (USA)). Jan 1980. 31p. California Energy Commission, Sacramento.

This report provides current information on the status of proposed power projects planned by the investor-owned electric utilities, municipal utilities, irrigation districts, and the Department of Water Resources. Facilities are considered in four categories: under construction, under regulatory review, in advanced planning, or in preliminary-planning stages. Currently, the California utilities plan resource additions between 1980 and 1991 of 27,970 MW. Of this amount, approximately 25% or 6900 MW of capacity, is presently under construction, 35% or approximately 9800 MW is under regulatory review, 27% or 7500 MW is in advanced planning stages, and 13% or 3700 MW is in preliminary planning stages. Details of firm capacity and energy-purchase contracts along with recent significant changes in the plans of the eleven utilities in the survey are summarized.

33738 (P—300-80-005) **Environmental implications of electric-utility supply plans, 1978-2000.** (California Energy Commission, Sacramento (USA)). May 1980. 104p. California Energy Commission, Sacramento.

California utilities plan to meet their projected demands for electricity during the next 20 years by continuing to rely heavily on existing generation sources along with adding many new facilities. Environmental interest in these plans usually focuses on the effects of building and operating the planned new facilities. However, to get the complete picture of the environmental implications of prospective electric generation, the effects of the total system, including the contributions of existing facilities, must be considered. Of particular importance for air quality is the extent to which generation from older,inefficient power plants is displaced as new, cleaner plants go into operation. The utilities' most-recently-announced plans propose major expansion of their fossil-fuel-fired generating capacity during the next 12 years, including the state's first coal-burning plants. During this period, a significant increase in nuclear generation from plants already in construction or in advanced planning stages is also planned. Whichever supply strategy is selected, the utilities foresee a more than doubling of their installed generating capacity and electricity generated by the year 2000. Assessment of the utilities' generation plans, incorporating the scheduled capacity additions (with long-term emphasis on either coal or nuclear) into total-system operations, reveals major environmental implications associated with the plans' implementation. This report is devoted mostly to these implications (air quality, water resources and quality, land use, nuclear wastes, and coal plant ash and sludge). 43 references, 25 figures, 8 tables, and footnotes.

33739 (P—500-80-015) **Estimating utilities' prices for power purchases from alternative energy resources.** Marcus, W.B.; Weisenmiller, R.B. (California Energy Commission, Sacramento (USA)). Mar 1980. 19p. California Energy Commission, Sacramento.

Federal and state regulations require California utilities to pay prices based on the full cost of oil-fired generation to cogenerators and owners of other generating facilities using renewable resources. These prices will exceed 4 cents per kWh in 1980 and are expected to increase to 7 to 13 cents per kWh by 2000 before inflation is factored in. Alternative energy proposals will be much more attractive economically at these higher prices than under previous utility-pricing practices. This report presents estimates of present and forecast prices of energy and generating capacity based on existing Energy Commission, Public Utilities Commission, and utility data for use by consulting engineers, economists, and others preparing feasibility studies.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

33740 (JPL-PUB—80-48(Vol.2)) **Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses.** Vaisnys, A. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1980. Contract NAS-7-100-955267. 271p. NTIS, PC A12/MF A01.

This Volume provides supporting analyses and data from the JPL/Boeing Contract, A Study of a Space Communication System for Electric Utility Load Management. The material, (1) presents an overview description of the system concept, (2) identifies and defines the functions associated with distribution automation and control, (3) defines communication system requirements, (4) examines important factors related to formulating viable communication concepts, (5) discusses the relationship of various design factors to utility operating practices, (6) reports the results of the cost analysis, and (7) describes several ways in which the concept could be integrated into the utility industry.

33741 (P—500-80-019) **Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system.** (California Energy Commission, Sacramento (USA)). Apr 1980. 57p. California Energy Commission, Sacramento, CA.

An analysis of proposals to expand the Pacific Northwest-Southwest transmission intertie system is summarized. The benefits of constructing additional intertie capacity are discussed. (LCL)

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 33696, 33759, 33762, 33763, 33764, 33779

33742 (EPRI-EA—1471) **Trends in energy use in industrial societies. Final report.** Dunkerley, J.; Alterman, J.; Schanz, J.J. Jr. (Resources for the Future, Inc., Washington, DC (USA)). Aug 1980. 235p. NTIS, PC A11/MF A01.

The amount of energy consumed relative to a given amount of output (the energy/GDP ratio) varies considerably among selected industrial countries and over time within the same countries. The objective of this study is to investigate the causes of these variations, particularly over time. The influence of changes in energy-supply systems, composition of output, energy prices, geographical characteristics, and tastes on these variations is considered. The study found that: (1) changes in energy-supply systems accounted for part of these variations in energy/GDP ratios; (2) changing composition of output also contributed to variations in energy/GDP ratios; and (3) low US energy prices contributed to higher US energy consumption relative to income, while the 1974 rise in energy prices contributed to the general decline in energy/GDP ratios after that year. If energy consumption is to achieve stated conservation targets, however, stronger pricing and conservation policies may be needed. 56 references, 3 figures, 92 tables.

33743 **Energy consumption: case of the Ivory Coast, Senegal and Ghana.** Yao, K. Tucson, AZ; Univ. of Arizona (1980). 151p. University Microfilms Order No. 80-17,799.

Thesis (Ph. D.).

The thesis examines the consumption of electricity and gasoline in the Ivory Coast, Ghana, and Senegal. Its main objectives are: (1) to investigate the determinants of the demand for gasoline and the demand for electricity by households and firms; (2) to forecast the level of electricity and gasoline consumption for the years 1980 to 1985; and (3) to recommend measures to curb the rate of increase in the demand for energy and to reduce the dependence upon imported oil. The choice of the models used in the estimation of the demand for gasoline and the demand for electricity by households and industries were greatly influenced by the fact that energy consumption is associated with that of other complementary durable goods. The results based on the gasoline demand equations indicate that income is a major determinant of gasoline consumption in Senegal, while in the Ivory Coast, habit formation and/or stock adjustment are the determinant factors. As far as price is concerned, it has consistently negative elasticities both across countries and specifications, but is not significant. For the residential demand for electricity, the results are much more encouraging. All of the countries show that price and the social and demographic factors and per-capita income are major predictors of residential electricity consumption. Their relative importance differ, however, both across countries and specification.Finally, the results for the industrial demand for electricity indicate that price, capital stock, and wage have an influence on the level of electricity consumed in the Ivory Coast, Senegal and Ghana. In addition to the variables mentioned above, output is also an important predictor of industrial electricity consumption in the Ivory Coast.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 33368, 33712, 33814

33744 (SERI/TP—744-661) **Developing common information elements for renewable energy systems: summary and proceedings of the SERI/AID workshop.** Ashworth, J.H.; Neuendorffer, J.W. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-77CH00178. 125p. (CONF-800250—). NTIS, PC A06/MF A01.

From Workshop on evaluated systems for renewable energy systems; Golden, CO, USA (20 Feb 1980).

This report describes the activities, conclusions, and recommendations of the Workshop on Evaluation Systems for Renewable Energy Systems sponsored by the Agency for International Development and SERI, held 20-22 February 1980 in Golden, Colorado. The primary objectives of the workshop was to explore whether it was possible to establish common information elements that would describe the operation and impact of renewable energy projects in developing countries. The workshop provided a forum for development program managers to discuss the information they would like

to receive about renewable energy projects and to determine whether common data could be agreed on to facilitate information exchange among development organizations. Such information could be shared among institutions and used to make informed judyments on the economic, technical, and social feasibility of the technologies. Because developing countries and foreign assistance agencies will be financing an increasing number of renewable energy projects, these organizations need information on the field experience of renewable energy technologies. The report describes the substance of the workshop discussions and includes the papers presented on information systems and technology evaluation and provides lists of important information elements generated by both the plenary sessions and the small working groups.

SOLAR

REFER ALSO TO CITATION(S) 33376, 33377, 33385, 33386, 33388, 33389, 33390, 33391, 33392, 33446, 33461, 33470, 33471, 33481, 33484, 33510, 33521

GEOTHERMAL

REFER ALSO TO CITATION(S) 33566, 33567, 33568, 33578

OTHER

REFER ALSO TO CITATION(S) 33360, 33365, 33366, 33414, 33415, 33436, 33582, 33583, 33791, 34062, 34116

ENERGY CONVERSION

ENERGY CONVERSION

MHD GENERATORS

MATERIALS, COMPONENTS, AND AUXILIARIES

33745 (DOE/ET/10815—T2) **Evaluation of a Coriolis mass flow meter for pulverized coal flows.** Baucum, W.E. (Tennessee Univ., Tullahoma (USA). Space Inst.). Dec 1979. Contract AC01-79ET10815. 23p. NTIS, PC A02/MF A01.

An investigation of a new Coriolis mass flow meter was carried out to determine the feasibility of using it to meter the multiphase flow of pulverized coal-transport gas mixtures. The Coriolis meter accurately measured dense phase coal flows on a continuous basis, producing an output which was a linear function of the coal flow. In less dense flows the meter monitored flow fluctuations and slugging, but when slugging became substantial the meter behaved erratically. Because the meter indicates flow fluctuation and slugging, it promises to be a valuable instrument for evaluating new coal delivery systems as well as for monitoring and adjusting flow in established systems.

DUCT ENGINEERING AND FLUID DYNAMICS

33746 (CONF-781009—2) **Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy). Feb 1980. 214p. NTIS, PC A10/MF A01.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The present stage of development of MHD energy conversion is responsible for a new class of theoretical problems on MHD channel flows. Until the late 1970's, most theoretical efforts were aimed at solving modeling problems to investigate the principal physical phenomena in the channel and at developing the foundation of engineering methods of calculating MHD channel flows. Presently, it is most important to increase the accuracy of engineering methods of calculations and to perform numerical modeling of real flows in the channel to obtain data required in designing different types of MHD generators. At the same time, the design of MHD generators frequently leads to a new class of problems which have not been previously analyzed by numerical modeling. In a new approach developed in applied MHD, the general system of equations is separated into electrodynamic and hydrodynamic parts. This technique is very useful in investigating electrodynamic problems in the MHD channel. Solution of axial and transverse electrodynamic problems makes it possible to determine the optimal stucture configuration and loading schemes for segmented channels. Methods based on parametrization of numerical solutions and application of variational calculus are quite effective in such applications. Numerical solution of the general two-dimensional MHD problem is usually obtained on the assumption that the flow is inviscid. The most interesting aspect of this line of research is the investigation of the effect of channel construction and loading on gas-dynamic parameters. The principal results of this type of research obtained primarily at the Institute of High Temperatures of the Soviet Academy of Sciences and the Mechanics Institute of the Moscow State University during 1970 to 1977 are presented.

THERMIONIC CONVERTERS

33747 (DOE/NASA/1062—6) **Optimal thermionic energy conversion with established electrodes for high-temperature topping and process heating.** Morris, J.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1980. Contract AI01-77ET13111. 34p. (NASA-TM—81555). NTIS, PC A03/MF A01.

Advantages of thermionic energy conversion (TEC) have been counted and are recounted with emphasis on high-temperature service in coal-combustion products. Efficient, economical, nonpolluting utilization of coal here and now is a critically important national goal. And TEC can augment this capability not only by the often proposed topping of steam power plants but also by higher-temperature topping and process heating. For these applications, applied-research-and-technology (ART) work reveals that optimal TEC with ~ 1000-to ~ 1100 K collectors is possible using well-established tungsten electrodes. Such TEC with 1800 K emitters could approach 26.6% efficiency at 27.4 W/cm^2 with ~ 1000 K collectors and 21.7% at 22.6 W/cm^2 with ~ 1100 K collectors. These performances require 1.5- and 1.7-eV collector work functions (not the 1-eV ultimate) with nearly negligible interelectrode losses. Such collectors correspond to tungsten electrode systems in ~ 0.9- to ~ 6-torr cesium pressures with 1600-to-1900 K emitters. Because higher heat-rejection temperatures for TEC allow greater collector work functions, interelectrode-loss reduction becomes an increasingly important target for applications aimed at elevated temperatures. Studies of intragap modifications and new electrodes that will allow better electron emission and collection with lower cesium pressures are among the TEC-ART approaches to reduced interelectrode losses. These solutions will provide very effective TEC to serve directly in coal-combustion products for high-temperature topping and process heating. In turn this will help to use coal-and to use it well.

FUEL CELLS

DESIGN AND DEVELOPMENT

33748 (ANL—80-33) **Advanced fuel cell development. Progress report, October-December 1979.** Pierce, R.D.; Kucera, G.H.; Kupperman, D.S.; Poeppel, R.B.; Sim, J.W.; Singh, R.N.; Smith, J.L. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 47p. NTIS, PC A03/MF A01.

Advanced fuel cell research and development activities at Argonne National Laboratory (ANL) during the period October-December 1979 are described. These efforts have been directed toward understanding and improving components of molten carbonate fuel cells and have included operation of 10-cm square cells. The principal focus has been on the development of electrolyte structures ($LiAlO_2$ and Li_2CO_3-K_2CO_3) that have good electrolyte retention and mechanical properties as well as long-term stability. This effort included work on preparation of sintered $LiAlO_2$ as electrolyte support, use of a scanning laser acoustic microscope to evaluate electrolyte structures, and measurements of the thermal expansion coefficients of various mixtures of β-$LiAlO_2$ and carbonate eutectic.

33749 (DOE/ET/11300—) **Cell and stack design alternatives. Fourth quarterly report, May 1, 1979-July 29, 1979.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Aug 1979. Contract AC03-78ET11300. 79p. NTIS, PC A05/MF A01.

Progress on the design of a phosphoric acid fuel cell total energy system for an apartment complex is reported. Studies include electric utility load sharing, thermal storage/terminal unit interface, domestic hot water system, methane conditioner model, and fuel cell testing and manufacturing. (WHK)

33750 (DOE/ET/11300—1) **Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979.** (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Feb 1980. Contract AC03-78ET11300. 328p. NTIS, PC A15/MF A01.

The work described comprised the first phase of a planned six phase program to develop commercially viable phosphoric acid fuel cell (PAFC) driven on-site integrated energy systems (OS/IES). The

Phase I effort was organized as three major technical tasks; (1) study of system design alternatives; (2) fuel cell design alternatives; and (3) methane conditioner study. It was decided that comprehensive modeling of one application would most effectively utilize the resources available for the study of systems design alternatives. A 48 unit apartment complex located in Albany, New York and built to HUD minimum standards was selected as being typical of the applications that will be served by the systems. The time varying space conditioning (HVAC) and electrical requirements including the effects of varying weather conditions, living habits and occupancy patterns were modeled. These requirements formed the basis for comparing the performance and cost of the alternative configurations with each other and with a conventional system. Five basic alternative OS/IES configurations plus four variations were selected from a preliminary list of 13 basic configurations for detailed performance nd cost evaluations. Study procedures and results are presented in detail. (WHK)

33751 (DOE/ET/11300—T1) **Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). May 1979. Contract AC03-78ET11300. 66p. NTIS, PC A04/MF A01.

Progress on a design study for an acid electrolyte fuel cell total energy system for an apartment complex is reported. Work on heat exchanger design, system models, fuel cell analysis, methane conditioner design, and management and documentation are reported. (WHK)

33752 (DOE/ET/11300—T2) **Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979.** (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 14 Feb 1979. Contract AC03-78ET11300. 78p. NTIS, PC A05/MF A01.

Progress on a program to develop commercially viable phosphoric acid fuel cell driven on-site integration energy systems is presented. A mass and energy balance was completed for one operating point of a selected power generation sub-system with a power output of 119 kW. Potentially, 87% of the LHV of the input fuel is available as bus bar electricity or useful heat. A 2 kW stack of conventional design and a 0.5 kW DIGAS cooled stack have been constructed and are on test at ERC. Renovation of a space for the Westinghouse stack test facility is underway and procurement of equipment has been initiated. The coupled cell temperature - current density analysis has been modified to include the effects of turbulent coolant flow and extended to permit analysis of up to 10 process plates between cooling plates. The REFORM computer program was verified by comparison with data received from the government project manager. A method for predicting carbon deposition was developed and compared with data from the literature.

33753 (DOE/ET/11300—T3) **Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Nov 1979. Contract AC03-78ET11300. 19p. NTIS, PC A02/MF A01.

Work on the design of an acid electrolyte fuel cell total energy system for an apartment complex is reported. Fuel cell stack testing, the methane conditioner study, and management and documentation are described. (WHK)

33754 (SAN—11276-4) **Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980.** (Institute of Gas Technology, Chicago, IL (USA)). May 1980. Contract AC03-78ET11276. 405p. NTIS, PC A18/MF A01.

The objective of this program was to develop a cell package with (a) cost-effective cell components, (b) performance satisfying utility requirements, and (c) the capability of being repeatedly thermally cyclable. The effort was conducted along three major and closely interrelated tasks. Task 1 involved the quantification of the thermomechanical behavior of the electrolyte tile, formulation of the methodology required to predict the stresses generated in the cell package during a thermal cycle, and specification and design of cell components that both reduce the thermally generated stresses and are cost effective. In Task 2, the preferred electrolyte tile support, the factors/mechanisms responsible for morphological transformations, and cost-effective electrolyte powder and electrolyte tile fabrication processes were determined. Task 3 was to verify the performance, endurance, and thermal cycling characteristics of standard (baseline) and developmental cell components in both laboratory (3-cm^2) and bench-scale (94-cm^2) testing. Progress is reported in detail. (WHK)

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 33748

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 33748, 33754

33755 (DOE/ET/11320—T1) **High temperature fuel cell research and development. Final technical status report, 1 March 1979-31 March 1980.** Lessing, P.A. (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). May 1980. Contract AC03-77ET11320. 133p. NTIS, PC A07/MF A01.

The objective of the program has been to evaluate potential materials for their chemical and physical stability in molten carbonate fuel cell electrolyte. Eleven powdered candidate materials were selected based on previous physical and chemical stability tests at elevated temperatures on solid materials and/or their thermodynamic stability with respect to proposed degradation reactions. The eleven candidate materials, plus gamma lithium aluminate, were characterized prior to corrosion testing utilizing (a) Chemical Analysis, (b) X-ray Diffraction for Phase Identification, (c) Scanning Electron Microscopy (SEM), and (d) Surface Area Analysis (B.E.T.). The powders were corrosion tested initially for 200 hours by heating to 700°C in a mixture of 62% Li_2CO_3-38% K_2CO_3 under a fuel gas atmosphere. The gas composition was based on reformed Naphtha at 700°C and consisted of 50.2% H_2, 10.8% CO, 9.5% CO_2, and 29.5% H_2O. The samples were tested in an inert container made by coating the interior of alumina crucibles with a layer of 0.002-inch gold. Seven of the original test materials (Al rich $MgAl_2O_4$, Mg rich $MgAl_2O_4$, Al_2(/sub 1-x/)Cr/sub 2x/O_3, $CaZrO_3$, $MgTa_2O_6$, $CoAl_2O_4$, and $MgZrO_3$) were eliminated from further testing after completion of the 200-hour test. The remaining materials (ZrO_2 stabilized with CaO, ZrO_2 stabilized with Y_2O_3 and Cr_2O_3, Y_2O_3 - Al_2O_3, γ-$LiAlO_2$, ThO_2, and CeO_2 as a potential substitute for ThO_2) were corrosion tested for 1000 hours under the same conditions as the previous 200-hour test. Results are presented and discussed. Powders of ZrO_2 stabilized with Y_2O_3 and Cr_2O_3, ThO_2, and γ-$LiAlO_2$ show the most corrosion resistance to 62% Li_2CO_3-38% K_2CO_3 at 700°C under a reformed Naphtha fuel gas atmosphere for 1000 hours. (WHK)

33756 (DOE/NASA/0150—80/4) **Cathode catalyst for primary phosphoric acid fuel cells. Fourth quarterly report, April-June, 1980.** Walsh, F. (Eco-Control, Inc., Cambridge, MA (USA)). 1980. Contract AI03-79ET11272. 19p. (NASA-CR—165135). NTIS, PC A02/MF A01.

Alkylation of Vulcan XC-72 has been shown to provide the most stable bond type for linking CoTAA to the surface of the carbon; this result is based on data obtained by cyclic voltammetry, pulse voltammetry and by release of ^{14}C from bonded CoTAA. Initial screening of dimeric CoTAA has shown it to be an active catalyst based on pulse voltammetry results. Commercially available PTFE has been shown to be stable for two months in 200°C 85% phosphoric acid based on lack of change in surface wetting properties, IR and physical characteristics.

APPLICATIONS

REFER ALSO TO CITATION(S) 33453, 33838

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 33379, 33380, 33690, 33742

33757 (DOE/EIA—0181) **Energy data report: annual energy balance, 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 8p. NTIS, PC A02/MF A01.

US energy production in 1978 increased for the third consecutive year. The 61.0 quadrillion Btu produced in 1978 was 0.63 quadrillion Btu or 1.0% greater than that during 1977 and represented the largest annual increase since 1972. Petroleum (including crude oil, lease condensate and natural gas plant liquids) was the nation's principal domestic energy source in 1978, supplying 33.8% of total production. Electricity production from nuclear powerplants increased 10% in 1978 to a record 276 billion kWh, 12.5% of total energy output. Hydropower electricity production totaled 281 billion kWh, 27.1% above the 1977 level when output was its lowest in recent years because of drought conditions in western states. US energy consumption in 1978 totaled 78.01 quadrillion Btu, 1.9% higher than that during 1977. Consumption of refined petroleum products, the major item of energy consumption, was 37.79 quadril-

lion Btu in 1978. This represented 48.4% of total energy consumption and was 1.6% greater than the 1977 level. Natural gas and coal consumption declined slightly during 1978. Non-fossil sources continued to provide a growing share of energy consumption, accounting for 7.9% of the total in 1978 compared with 5.3% in 1973. Consumption of energy in the electric utilities sector in 1978 was 4.9% above the 1977 level, the largest increase for any sector. Energy consumption in the residential and commercial sector and the transportation sector increased a modest 1.6% and 2.6%, respectively. Only the industrial sector had a decrease, a decline of 2.3%. In current dollars, the price of domestically produced energy continued to increase.

BUILDINGS

REFER ALSO TO CITATION(S) 33386, 33465, 33481, 33799, 33800, 33803, 33804, 33805, 33806, 33807, 33808, 33809, 33810, 33811, 33812

33758 (CONF-790401—, pp 257-265) **University of Minnesota Grid-Connected Integrated Community Energy System.** O'Gara, J.C. (Univ. of Minnesota, Minneapolis). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

The purpose of this program is to demonstrate the advantages of combining heat and electric-production capability and end-use heat systems in which the electric-production system operates according to the demand of the community heating and cooling end-use systems with the electrical power generated during heat production considered a by-product of the system. The heat production, heat use, and cogenerated electricity fed to the utility operate as a system. The fuel for the heat-generating system will be low-Btu, low-sulfur Montana coal, and hospital and general solid wastes. The major generating system produces heat in steam and hot water and by-product electric power delivered into the local electric utility grid system. Engineering studies indicate that fuel use by this system is 46% less when compared with a large electric utility generating condensing power. The demonstration Grid-Connected Integrated Community Energy System consists of expansion of the University's steam-generation central plants and inclusion of a basic plan for cogeneration of by-product electricity and three add-on options to the basic plan.

33759 (CONF-800210—4) **New applications of energy storage in electric-heating and -cooling systems.** Asbury, J.G. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01.

From IEEE Region 6 conference; San Diego, CA, USA (20 Feb 1980).

Electricity, in combination with appropriate load-management techniques, is a cost-effective method of providing building heating and cooling services. Storage systems that enable the use of nighttime, off-peak, energy to meet the following day's load are among the most-promising load-management techniques. Studies at Argonne evaluated the total cost of providing space-heating and -cooling services with electricity and then compared these costs with oil and gas-based systems. Detailed cost-allocation models were used to compute gas- and electric-utility costs of supply. The ANL SIMSTOR model, which uses hourly synoptic load and weather data, represents a robust methodology for estimating the long-run marginal costs of supplying device-specific electric loads. A number of different electric technologies were evaluated including: electric storage heating, storage air conditioning, dual-fuel heating, and solar heating with electric backup. An important finding is that several electric-based heating technologies are cost-competitive with oil and natural gas heating.

33760 (EPRI-EM—1348(Vol.1)) **Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report.** Merriam, R.L.; Lee, W.D.; Carr, J.E.; Boyce, S.E.; Bierenbaum, H.S. (Little (Arthur D.), Inc., Cambridge, MA (USA); Planning Research Corp./Systems Services Co., Cocoa Beach, FL (USA); Applied Energy Systems, Inc., Cape Canaveral, FL (USA)). Mar 1980. 47p. NTIS, PC A03/MF A01.

The potential energy savings from refrigerant heat recovery in the residential, commercial and industrial sectors and its impact on electric utilities were assessed. It was concluded that the technology for heat recovery is well established in all sectors and in comparison with solar water heating equivalent energy savings can be achieved at a fraction of the cost. The critical barriers to implementation in the residential sector are primarily institutional in nature. In the absence of barriers, the potential market for heat recovery could be substantial, with an annual energy savings of 0.25 x 10^{15} Btu in 1990. The economic impacts on summer peaking electric utilities were found to be favorable in all regions in central air conditioner applications. Annual net cost savings to the utility were estimated to be $10 to $50 per residential application. In the commercial sector and food processing segment of the industry sector, refrigerant heat recovery could reduce total energy consumption by about 0.28 x 10^{15} Btu, with the major savings from applications in existing buildings. The major barriers to acceptance are lack of familiarity with the technology and uncertainty relating to future codes and standards. The potential impacts on summer peaking utilities were found to be favorable. Recommendations for removing the critical barriers in all three sectors are presented, including demonstrations of heat recovery technology.

33761 (Juel-Spez—57) **Transport and distribution costs of conventional heat-supply systems in the Federal Republic of Germany. Applied Systems Analysis report No. 13.** Duering, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Oct 1979. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01.

The availabilities of energy sources on the world energy market have changed as a result of natural and political limitations. It has become a pressing task to find out how present power transport and distribution systems can be adapted to supply problems of the future, what rentabilities they can achieve, and what obstacles they will have to meet. After an analysis for a technical and economic assessment of existing heat-transfer systems, small-scale heat-demand structures are set up in particular for the household and small-consumer sector. This is followed by a picture of the technical supply conditions for electric power, district heat, natural gas, light fuel oil, and solid fuel, derived by assigning network elements with comparable efficiencies and transfer capacities. This way, the internal structure of the transport and distribution costs of present heat-supply systems is obtained for West Germany on the basis of standardized - and thus comparable - supply contributions of the various energy sources. The results as specific costs of the supply systems are compared and discussed in regard to the number of network connections in communities.

33762 (LA—7689-M(Ver.2.1)) **DOE-2. Part 1. Reference manual. Version 2.1.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-48;W-7405-ENG-36. 731p. (LBL—8706(Rev.1)). NTIS, PC A99/MF A01.

This document describes the DOE-2 computer program, which is capable of rapid and detailed analysis of energy consumption in buildings. A new, user-oriented language, the Building Description Language, was written to allow simplified manipulation of the many variables used to describe a building and its operation. DOE-2 includes: a Building Description Language (BDL) program; a LOADS analysis program; a SYSTEMS program; a PLANT program; an ECONOMICS analysis program; a REPORT program; and a set of WEATHER ANALYSIS programs. A library of weather data has been prepared, which includes temperature, barometric pressure, wind, and cloud data for 60 locations in the US. These data are used to calculate the thermal response of a building for each hour of a year. A preliminary library of schedule data was also prepared to illustrate typical hourly conditions that can be used to specify desired temperature variations, occupancy patterns, lighting, and equipment operation. The construction library contains data on the properties of walls, roofs, and floors. The materials library contains data on the common building materials. The Constructions, Materials, and Weather libraries are available in machine-addressable form; the other library data are available only in printed form. Finally, input and output samples are included to illustrate the use of DOE-2.

33763 (LBL—8678(Rev.1)) **DOE-2 sample run book. Version 2.1.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-48;W-7405-ENG-36. 627p. NTIS, PC A99/MF A01.

Sample DOE-2 energy analysis runs are presented for four different buildings: a simple structure; a 31-story office building; a small medical office building; and a single-family residence. The simple structure introduces the new user to DOE-2. The large office building demonstrates runs on a variety of systems and plant options. The medical building demonstrates a number of available options, such as simulation of shading surfaces and use of heat recovery. The single-family residence illustrates use of conventional residential heating and cooling systems as well as active solar space heating. The following is given for each run: a simplified drawing of the building, detailed specifications, DOE-2 input, and selected output reports. The building specifications were compiled to allow the reader to relate the input to the actual physical characteristics of the architecture, distribution system, and primary equipment for each building. The input shown is that echoed by the program, complete with line numbers supplied by the Building Description Language processor. All of the runs were made on the Lawrence Berkeley Laboratory CDC-7600 computer, using DOE-2.1. The weather information used for all runs is the Test Reference Year for downtown Chicago (1974). A statistical summary of this weather year and graphical plots showing hourly weather variables are given in the

last section of this manual. The examples are briefly described, followed by specifications, input, and output for all of the runs.

33764 (LBL—8688(Rev.1)) **DOE-2: BDL summary, Version 2.1.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36;W-7405-ENG-48. 95p. NTIS, PC A05/MF A01.

The basic information on all commands and keywords in the Building Description Language (BDL) is presented in concise form. Charts on the LOADS, SYSTEMS, PLANT, ECONOMICS, and SOLAR commands and keyword summaries are included. References are from geographical data for the 50 largest US cities; international time zones map; and the perpetual calendar.

33765 (LBL—9803) **Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows.** Klems, J.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 12p. (CONF-791233—8). NTIS, PC A02/MF A01.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Windows have the highest thermal conductance (or U-value) of all the elements in a building envelope. A small (3 ft x 4 ft opening) calibrated hotbox was built for studying methods of improving window thermal performance. Generic approaches to window thermal control are compared, novel methods of improving window performance are identified, and the mechanisms by which actual window performance may differ from theoretical are studied. The construction and instrumentation of the hotbox, the methods by which the box was calibrated, and the limits on its accuracy are described. The results of a study of prototype windows which serves the dual purpose of illustrating the methodology and some interesting options for window improvement are presented.

33766 (LBL—9821) **Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays.** Condon, P.E.; Carroll, W.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 25p. (CONF-791233—7). NTIS, PC A02/MF A01.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A method is described for determining dynamic thermal performance of building envelopes in situ. The method is passive in the sense that only heat flux and temperature measurements are made - experimental conditions are generated by the natural environment of the wall. Included in the method are procedures for time-averaging of large quantities of data using numerical techniques. This approach makes it possible to collect and analyze digital data rapidly enough to provide essentially a continuous record of performance and, at the same time, store the data in a form convenient for subsequent analysis. Dynamic models are developed, as are methods of correlating them with measured data to determine model parameters representative of dynamic-performance characteristics. Sample data obtained from a typical frame cavity wall were measured and fitted to the models. The relationship between the dynamic-performance characteristics of this wall and traditional steady-state characteristics is discussed. The method described avoids many of the limitations inherent in steady-state experimental measurements.

33767 (LBL—10789) **Cost effectiveness of long life incandescent lamps and energy buttons.** Verderber, R.; Morse, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 7 Apr 1980. Contract W-7405-ENG-48. 19p. (EEB—80-03). NTIS, PC A02/MF A01.

Long-life replacement lamps for the incandescent lamp have been evaluated with regard to their cost effectiveness. The replacements include the use of energy buttons that extend lamp life as well as an adaptive fluorescent circline lamp that will fit into existing incandescent lamp sockets. The initial, operating, and replacement costs for one million lumen hours are determined for each lamp system. It is found that the most important component lighting cost is the operating cost. Using lamps that are less efficient or devices that cause lamps to operate less efficiently are not cost-effective. The adaptive fluorescent circline lamp, even at an initial unit cost of $20.00, is the most cost-effective source of illumination compared to the incandescent lamp and lamp systems examined.

33768 (NBS-BSS—114) **Effect of resource impact factors on energy conservation standards for buildings.** Weber, S.F. (National Engineering Lab. (NBS), Washington, DC (USA)). Sep 1978. Contract AT01-77CS26010. 60p. NTIS, PC A04/MF A01.

The question of the proper value for energy to be used in the development of optimum (i.e., cost-effective) energy conservation performance standards for buildings is addressed. It is found that the appropriate value for energy is its social value, which should be determined through the development and application of Resource Impact Factors (RIF's). Some guidelines are provided for the formulation and development of RIF's. A life-cycle cost minimization model for determining the optimum conservation standard is employed to show how the use of RIF's would generally lower the maximum allowable energy consumption specified in the standard. Indeed, it is found that the higher the RIF value, the lower the energy consumption allowed by the standard, although this effect steadily diminishes as the RIF value increases. Moreover, the additional energy savings resulting from using RIF's are shown to increase as the severity of the climate increases. When two important restrictive assumptions of the model are relaxed, these same relationships between energy consumption and the RIF value on the one hand, and between the extra energy savings due to RIF's and the climate on the other hand, are both maintained. Finally, geometric and algebraic measures are derived for the net gain in economic efficiency that would result from using RIF's in developing energy conservation performance standards.

33769 (ORNL/Sub—7470/1-V3) **Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Jun 1980. Contract W-7405-ENG-26. 406p. NTIS, PC A18/MF A01.

This volume consists of seven appendices related to ACES, the first three of which are concerned with computer programs. The appendices are entitled: (A) ACESIM: Residential Program Listing; (B) Typical Inputs and Outputs of ACESIM; (C) CACESS: Commercial Building Program Listing; (D) Typical Weather-Year Selection Requirements; (E) Building Characteristics; (F) List of Major Variables Used in the Computer Programs; and (G) Bibliography. 79 references.

33770 **Energy conservation opportunities. Volume II.** Jefferson City, MO; Missouri Energy Program (1978). 41p. (NP—25039).

Energy-conservation opportunities are identified for the following: heating and cooling, ventilation, infiltration and heat loss, electric systems, kitchens, cafeterias, and elevators. Information on implementing the conservation measures is presented which discusses some of the basic factors affecting energy consumption. The final section includes tables to utilize in achieving a close estimate of the energy savings possible from implementing specific conservation measures.

33771 **Massachusetts study of the retrofit insulation industry.** Boston, MA; State Building Code Commission (1978). 38p. (NP—25056).

An investigation of the retrofit insulation industry's current practices in Massachusetts points clearly to a need for regulating insulation installers. It is recommended that a mandatory licensing program be implemented, so as to assure that all elements appropriate for a regulatory response be achieved. If it takes any significant length of time to establish such a program, and to verify that contractors have complied with the instructional and testing criteria, the state should take some immediate action as an interim step. Infrared thermography studies were done to identify installation problems and laboratory tests were performd on product samples. Public meetings were held in Boston, Fall River, and Springfield to hear comments about the nature and extent of problems in insulation retrofits and how these problems might best be remedied by state action. Preliminary results indicate that a clear need exists for labeling and advertising in installation practices.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 33691, 33692, 33693

33772 (AES—1/80) **Social factors affecting energy use and conservation in the home.** Crossley, D.J. (Griffith Univ., Nathan (Australia)). Mar 1980. 160p. Griffith Univ., Brisbane, Australia.

There is a very wide variation between individual households in the energy they use directly in the home. This variation occurs both in the total magnitude of energy used, and in the contributions made to total domestic energy use by the various categories of domestic tasks. Part of this variation is due to physical factors such as climate and physical features of the dwelling, and part is due to social factors such as number of people in the household and household behavior. People of higher socio-economic status (income, education, occupation) use more energy than those of lower status. They also have a greater ability to conserve more, and to purchase more energy than people of lower status; what they actually will do depends on the particular situation and circumstances. The evidence on the effects of people's attitudes, beliefs, and intentions on energy use and conservation behavior is confused by methodological inadequacies, but it seems that those attitudes, beliefs, and intensions directly related to a person's everyday experience of using and saving energy do affect his/her behavior. A social survey carried out in Brisbane in 1977 demonstrated that social factors were effective in influencing intentions towards energy-conserving practices, and patterns of energy-using behavior, in the home amongst the study population. The main factor influencing

energy use and conservation appeared to be socio-economic status (income, education, occupation). Though the survey respondents were generally favourably oriented towards energy conservation, there was a general lack of correlation between beliefs and attitudes and energy-using behavior.

33773 (BNL—51171) **Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978.** McDonald, R.J.; Batey, J.E.; Allen, T.W.; Hoppe, R.J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract AC02-76CH00016. 65p. NTIS, PC A04/MF A01.

A laboratory study is made to measure the efficiencies of residential heating equipment. A direct measurement technique provides an accurate evaluation of the efficiency of residential heating units during full-load and part-load operation. The laboratory data is then used to determine annual fuel consumption and fuel-weighted seasonal efficiency for each heating unit based on typical operating parameters (size of residence, geographic location, and usage). The results of the study include both the evaluation of a wide range of hydronic (hot water) burner-boiler package units and the evaluation of retrofit items which are added to an existing heating system to enhance efficiency and performance. The combination of direct, accurate efficiency measurement, and calculation of annual fuel use provide a standard method for comparison of individual heating units and retrofit modifications on a common and realistic basis. This allows a cost effectiveness analysis to be performed so that direct quantitative comparisons can be made.

33774 (CONF-800835—2) **Uncertainties in our understanding of energy conservation.** Hirst, E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From Symposium on energy modeling III: dealing with energy uncertainty; Chicago, IL, USA (4 Aug 1980).

There is wide and growing agreement on the potential benefits of energy-conservation measures. However, there is considerable uncertainty over the best means to obtain these benefits. Decision makers lack sufficient information to decide on the proper roles for private enterprise and for governments. The best mix of government activities is not known. Unfortunately, the data currently available are not adequate for dealing with these important issues. This paper discusses existing and emerging data sources that deal with these questions that can help improve our understanding of energy use and conservation. Development of comprehensive and accurate data bases is crucial to the improvement and intelligent application of energy-use models.

33775 (DOE/PE/03871—T1) **Potential for energy technologies in residential and commercial buildings.** Glesk, M.M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1979. Contract AC01-76PE03871. 153p. NTIS, PC A08/MF A01.

The residential-commercial energy technology model was developed as a planning tool for policy analysis in the residential and commercial building sectors. The model and its procedures represent a detailed approach to estimating the future acceptance of energy-using technologies both in new construction and for retrofit into existing buildings. The model organizes into an analytical framework all relevant information and data on building energy technology, building markets, and government policy, and it allows for easy identification of the relative importance of key assumptions. The outputs include estimates of the degree of penetration of the various building energy technologies, the levels of energy use savings associated with them, and their costs - both private and government. The model was designed to estimate the annual energy savings associated with new technologies compared with continued use of conventional technology at 1975 levels. The amount of energy used under 1975 technology conditions is referred to as the reference case energy use. For analytical purposes the technologies were consolidated into ten groupings: electric and gas heat pumps; conservation categories I, II, and III; solar thermal (hot water, heating, and cooling); photovoltaics, and wind systems. These groupings clearly do not allow an assessment of the potential for individual technologies, but they do allow a reasonable comparison of their roles in the R/C sector. Assumptions were made regarding the technical and economic performances of the technologies over the period of the analysis. In addition, the study assessed the non-financial characteristics of the technologies - aesthetics, maintenance complexity, reliability, etc. - that will also influence their market acceptability.

33776 (JHU/APL-GEM—007) **Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period.** Barron, W. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.; Johns Hopkins Univ., Baltimore, MD (USA). Center for Metropolitan Planning and Research). Apr 1980. Contract AI01-79ET27025;AI01-76ET28390. 48p. NTIS, PC A03/MF A01.

The most recent price projections that have been published for distillate heating fuels, natural gas, and electricity are reviewed. The projections include those made by EIA, DOE, BNL, Foster Associates, and SRI International. Projected distillate prices for 1990 range from Brookhaven's worst case real price of $8.80 per million Btu's to EIA's most optimistic case of $4.10 for that year compared to $6.10 prevailing in September 1979. Natural gas prices projected for 1990 fall within a more narrow band ranging up to $4.50 (Brookhaven's basecase) compared to $4.20 in September 1979. Electricity prices projected for 1990 range to $17.00 per million Btu's compared to the September 1979 average price of $15.50. Regional price differentials show the Northeast paying above national average prices for oil, natural gas, and electricity. The West enjoys the lowest energy price levels overall. Oil prices are relatively uniform across the country, while natural gas and electricity prices may vary by more than 50% from one region to another.

33777 (Juel-Spez—64) **Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16.** Kollmann, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Dec 1979. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01.

The knowledge of the regional structure of the heat demand in settlements is important for an assessment of the energy supply systems for the household and commercial sector under technical-economic aspects. The heat demand and its distribution are determined by heat load, heated area of settlements, and heat density. A method is introduced to determine the components of the heat demand in settlement areas of villages, cities, city size groups, and the whole Federal Republic of Germany in 1974. By this method, an attempt is made to show alternative possibilities of the heat demand development in 1990 with regard to energy savings.

33778 (LBL—8894(Rev.)) **Indoor air-quality measurements in energy-efficient residential buildings.** Berk, J.V.; Hollowell, C.D.; Pepper, J.H.; Young, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 50p. (CONF-790634—4(Rev.); EEB-Vent—80-8). NTIS, PC A03/MF A01.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

The potential impact on indoor air quality of energy-conserving measures that reduce ventilation is being assessed in a field-monitoring program conducted by the Lawrence Berkeley Laboratory. Using a mobile laboratory, on-site monitoring of infiltration rate, carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, ozone, sulfur dioxide, formaldehyde, total aldehydes, and particulates was conducted in three houses designed to be energy-efficient. Preliminary results show that energy-conserving design features that reduce air-exchange rates compromise indoor air quality; specifically, indoor levels of several pollutants were found to exceed levels detected outdoors. Although the indoor levels of most pollutants are within limits established by present outdoor air-quality standards, considerable work remains to be accomplished before health-risk effects can be accurately assessed and broad-scale regulatory guidelines revised to comply with energy-conservation goals.

33779 (LBL—9270) **Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1.** Carroll, W.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 68p. (CONF-791233—5; EEB-ENV—79-11). NTIS, PC A04/MF A01.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A comparison was made of heating- and cooling-load predictions made by three public-domain-building energy-analysis computer programs: NBSLD, BLAST 2, and DOE-2.1. DOE-2.1 analyses were made using both ASHRAE standard weighting factors (SWF's), and custom weighting factors (CWF's) calculated by the program for the specific thermal model. The thermal model used for the comparison is based on a typical, current-practice single-family detached residence. Three different kinds of comparisons were made: (1) Monthly and annual load calculations were compared for six locations spanning the range of climates in the continental US. (2) Predicted changes in annual heating and cooling loads (BLAST 2 and DOE-2.1 (CWF) only) from a baseline case were compared for a single climate (Washington, DC). (3) Hourly heating- and cooling-load predictions were compared for design days that are representative of summer, winter, and transitional-season weather conditions for a temperate climate. Annual heating-load predictions show generally good agreement for all climates and consistent predicted changes from one climate to another, with the exception of the DOE-2.1 (SWF) predictions, which show marked underestimates for mild heating climates. Both DOE-2.1 (SWF) and (CWF) annual cooling-load predictions are significantly higher (25% to 35%) than the (almost alike) BLAST 2 and NBSLD predictions for all climates

but one (the exception is believed to be coincidental). The quality of agreement between the BLAST 2 and DOE-2.1 (CWF) predictions for the load changes from the respective baselines was quite good for essentially all of the input variations examined. Design-day analyses for three typical days show acceptable agreement, with the greatest differences occurring in the predicted loads for the transitional-season design day, when heating and cooling loads are smallest.

33780 (LBL—10705) **Air infiltration measurement techniques.** Sherman, M.H.; Grimsrud, D.T.; Condon, P.E.; Smith, B.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 36p. (CONF-801019—1). NTIS, PC A03/MF A01.

From 1. International Energy Agency symposium of the air infiltration centre; Windsor, UK (6 Oct 1980).

A survey is presented of tracer-gas techniques for measuring air infiltration and includes a theoretical derivation of the equations, a description of each method, and a short description of the experimental procedure. A qualitative error analysis which concentrates on mixing problems is derived and used to compare the strengths and weaknesses of each method. The theory of multi-chamber infiltration measurement is derived for use in situations involving many interconnected spaces (network type models). A set of measurement techniques analogous to the single chamber techniques is discussed along with qualitative error analysis. The question of effective volume and mixing is addressed for both the single and multi-chamber cases. Also discussed is the general topic of non-tracer techniques for measuring infiltration.

33781 (NBS-TN—982) **Criteria for retrofit materials and products for weatherization of residences.** Rossiter, W.J. Jr.; Mathey, R.G. (eds.). (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Sep 1978. 75p. NTIS, PC A04/MF A01.

The DOE requested NBS to develop criteria for materials and products to be included in the DOE Weatherization Assistance Program. This program was established by Congressional legislation and was directed toward financially assisting low-income persons in retrofitting residences to conserve energy. In most cases, only energy-saving materials and products for which specifications and/or standards are available are to be included in the Weatherization Assistance Program. Because of statutory requirements labor costs for installing weatherization materials and products are not included in the program. Criteria for materials and products considered eligible under the Program are identified. The materials included are insulation and vapor barriers, storm windows and doors, caulking and weatherstripping, clock thermostats, replacement windows, and replacement glazing. The retrofit materials are listed by generic type and recommendations are made for their installation. During the course of the investigation and based upon interactions with industry representatives, materials and products other than those considered eligible under the DOE Weatherization Assistance Program were also given consideration. Those materials and products having energy savings potential but which are considered not eligible are discussed in the Appendices.

33782 (OTA-E—92(Vol.1)) **Residential energy conservation.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1979. 360p. GPO.

The potential for conserving energy in homes in terms of energy and cost is analyzed. Existing and promising technologies and a broad set of issues affecting the use of these technologies, how their level of use and effectiveness can be improved, and related Federal programs and policies are reviewed. The demand aspect of residential energy use, specifically those functions that consume most of a home energy budget, i.e., fuel to heat and cool space and to heat water, is emphasized. The human factors that play a major role in shaping energy consumption is addressed. Choices open to builders, designers, suppliers, local and state officials, lenders, utilities, owners, renters, and others are examined. The problem contains many economic, behavioral, and motivational variables, many technical and human unknowns, and many possible policy paths. The major findings lead to these conclusions: analysis of data on price and consumption, combined with research on consumption consumer motivation, indicates that the desire to save money is the principal motivation for changes in energy habits; one of the principal ways to improve energy use lies in the area of information and technology transfer; and the diversity of the housing stock, number of persons involved, requirements for technology transfer, and product availability all argue for careful pacing of Federal policy, based on setting goals over at least a decade.

33783 **Basic principles of heat loss and energy consumption in a house. Publication ECR No. 1.** Hilding, W.E. Storrs, CT; University of Connecticut (1978). 53p. (NP—25099).

The mechanics of building heat losses is described and the most economical steps which may be taken to minimize the heat losses are identified. The energy consumption data is presented in terms of gallons of fuel oil consumed annually by the various house components such as doors, windows, walls, ceilings, etc. The information is presented in 11 sections, i.e., energy consumption; insulation R factor; radiant energy; insulation (how it works); door and window heat loss; air infiltration and ventilation rates; the generation and dispersal of water vapor in a house; basement heat loss; the effect of turning down the thermostat; the heating efficiency of household furnaces; and the energy requirements of domestic hot water production.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 33785

33784 **Energy conservation standards for new nonresidential buildings.** Sacramento, CA; California Energy Commission (1980). 69p. (NP—25016).

The text of Article 2, Energy Conservation Standards for New Nonresidential Buildings is presented. The Divisions in the Article include: general provisions; energy budgets; nondepletable energy sources; building envelope; heating, ventilating, and air conditioning systems; heating, ventilating, and air conditioning equipment; service water heating; electrical distribution systems; and lighting.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 33784

33785 (NBS-BSS—113) **Life-cycle costing: a guide for selecting energy-conservation projects for public buildings.** Ruegg, R.T.; McConnaughey, J.S.; Sav, G.T.; Hockenbery, K.A. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Sep 1978. Contract AT01-77CS26010. 85p. NTIS, PC A05/MF A01.

This report provides a step-by-step guide for conducting life-cycle cost evaluations of energy conservation projects for public buildings. It explains the use of life-cycle costing analysis to evaluate and rank the cost effectiveness of alternative energy-conservation retrofit projects to existing public buildings, and to select the most cost-effective design for new buildings. Worksheets, illustrated with a realistic example, and a computer program are provided. This guide is compatible with a life-cycle costing guide prepared for DOE use in the Federal Energy Management Program by Federal agencies. The purpose of this report is to provide a guide to state and local governments for use in their energy-conservation programs.

33786 **Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries.** Jefferson City, MO; Missouri Energy Program (1978). 50p. (NP—25057).

Measures for saving energy in hospitals, schools, municipalities, and industrial buildings are identified. The document serves as a stepping stone into a complete energy-management program. An energy-conservation program has 4 basic parts: planning and organizing; surveying for areas of potential savings; implementing conservation steps; and keeping the program going. Each step is described and then specific opportunities are described for heating and cooling; ventilation; infiltration and heat loss; lighting; domestic hot and cold water; generating operating practices and equipment; interior-space utilization; electric systems; kitchen and cafeteria area; elevators and escalators; and refrigeration equipment. Information on implementing the programs is discussed.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 33713, 33714, 33715, 33716, 33717, 33718, 33719, 33720, 33722, 33723, 33724, 33774, 33775, 33777, 33784, 33786

TRANSPORTATION

AIR AND AEROSPACE

33787 (DOE/CS/05438—T1(Vol.1)) **Alternative energy sources for non-highway transportation: executive summary.** (Exxon Research and Engineering Co., Linden, NJ (USA)). Jun 1980. Contract AC05-77CS55438. 26p. NTIS, PC A02/MF A01.

A planning study was made for DOE on alternate fuels for non-highway transportation (aircraft, rail, marine, and pipeline). The study provides DOE with a recommendation of what alternate fuels may be of interest to non-highway transportation users from now through 2025 and recommends R and D needed to allow non-petroleum derived fuels to be used in non-highway transportation. In the near term (present-1985), there is unlikely to be any major change in the fuels used in any of the four modes of transportation except that the average quality of the marine fuel is likely to get

worse. In the mid-term period (1985-2000), there will be a transition to non-petroleum fuels, based primarily on shale oil derived liquids assuming a shale oil industry is started during this time.

33788 (DOE/CS/05438—T1(Vol.2)) **Alternative energy sources for non-highway transportation: technical section.** (Exxon Research and Engineering Co., Linden, NJ (USA)). Jun 1980. Contract AC05-77CS55438. 297p. NTIS, PC A13/MF A01.

Eighteen different alternative fuels were considered in the preliminary screening, from three basic resource bases. Coal can be used to provide 13 of the fuels; oil shale was the source for three of the fuels; and biomass provided the resource base for two fuels not provided from coal. In the case of biomass, six different fuels were considered. Nuclear power and direct solar radiation were also considered. The eight prime movers that were considered in the preliminary screening are boiler/steam turbine; open and closed cycle gas turbines; low and medium speed diesels; spark ignited and stratified charge Otto cycles; electric motor; Stirling engine; free piston; and fuel cell/electric motor. Modes of transport considered are pipeline, marine, railroad, and aircraft. Section 2 gives the overall summary and conclusions, the future outlook for each mode of transportation, and the R and D suggestions by mode of transportation. Section 3 covers the preliminary screening phase and includes a summary of the data base used. Section 4 presents the methodology used to select the fuels and prime movers for the detailed study. Sections 5 through 8 cover the detailed evaluation of the pipeline, marine, railroad, and aircraft modes of transportation. Section 9 covers the demand related issues.

RAILWAY

REFER ALSO TO CITATION(S) 33787, 33788

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 33691, 33819, 33820

33789 (BNL—50904) **Fleet operator data book (summer 1977 data). Volume 1. National data.** Wagner, J.R. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Sep 1979. Contract AC02-76CH00016. 54p. NTIS, PC A04/MF A01.

The purpose of this report is to present data useful for analyzing the marketability of alternative (i.e., nonconventional) vehicles in the fleet market. In the context of this report, fleet refers to a group of 10 or more light-duty highway vehicles (i.e., passenger cars and light trucks) operated by a corporation or by a government agency. The data describe acquisition behavior of fleet operators and the physical capabilities required of fleet vehicles. The primary source of the data is a survey which was mailed to fleet operators by the Bobit Publishing Company in the summer of 1977. Besides presenting data, this report discusses ways in which characteristics of alternative (especially electric) vehicles affect their likely penetration of the fleet market, and the important role which fleets can play in determining the overall market success of new technologies.

33790 **Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report.** Hartford, CT; Connecticut Department of Transportation (1978). 44p. (NP—25065).

Information is presented concerning the Three Point Program to reduce fuel consumption, traffic congestion, and air pollution. The three points of the program are as follows: foster carpooling, vanpooling, and charter express bus service (bus pooling) in private industry through the use of the Department's computer consultation services; construct additional interchange parking facilities to facilitate carpooling; and develop additional express commuter bus service between suburban areas and the central business districts of Connecticut cities.

SEA AND WATER

REFER ALSO TO CITATION(S) 33787, 33788

PIPELINE

REFER ALSO TO CITATION(S) 33787, 33788

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 33731

ENERGY SOURCES

REFER ALSO TO CITATION(S) 33776, 33814

33791 (CONF-800396—1) **Supplementing the energy and plant nutrient requirements through organic recycling.** Mahdi, S.S.; Misra, R.V. (Tata Energy Research Inst., Bombay (India)). 1980. 9p. NTIS (US Sales only), PC A02/MF A01.

From National symposium on recycling of residues of agriculture and industry; Ludhiana, India (Mar 1980).

Portions of Document are illegible.

In context of dwindling non-renewable energy resources and increasing health hazards because of environmental pollution, recycling of organic residues obtained through various sources like crops, animals, and human beings is becoming increasingly important. The organic residues obtained as wastes through these sources can be recycled effectively to meet scarce resources of energy and the plant nutrients, so vitally needed for our day-to-day activities and for raising agricultural production. Agriculture is the main stay of the Indian economy. Considerable quantities of crop residues available from agriculture can be utilized to serve as a source of organic fertilizers which not only provide plant nutrients but also improve soil health. The country has a large animal and human population. The animal and human wastes can be successfully used for production of energy and organic fertilizer by routing through biogas system. There is a need to develop an integrated energy and nutrient supply program. An action program is outlined.

33792 (NP—25047) **Make better use of energy: energy budgeting in farming.** (Hauptberatungsstelle fuer Elektrizitaetsanwendung e.V., Frankfurt am Main (Germany, F.R.)). [nd]. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01.

Following a brief introduction on energy carriers and efficiency in conversion processes, the energy demand in the agricultural field is considered. Energy-saving possibilities and ideas on how to save energy in the household and keeping animals in farming are listed with brief explanations. Besides heat insulation and recovery, heating systems as well as milk cooling with simultaneous production of warm water are considered.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 33946

33793 (CONF-7905177—1) **Reductions in energy usage at Manitoba Forestry Resources: energy conservation, fuel oil substitution and electrical cost control.** Hawrylak, M.; Magiera, E. (Manitoba Forestry Resources Ltd., The Pas (Canada)). 1979. 28p. NTIS (US Sales Only), PC A03/MF A01.

From Pulp and paper conference; Harrison Hot Springs, Canada (26 May 1979).

This paper describes a program by which fossil-fuel usage at Manitoba Forestry Resources Ltd. has been reduced by 58% since 1976. This reduction, equivalent to six million gallons of Bunker C fuel annually, was achieved by energy conservation and oil replacement by hog fuel. A project to increase hog-fuel utilization by 50,000 tons per year is described in detail. Major achievements in energy conservation and optimization of power costs are also included.

33794 (DOE/CS/40031—T1) **Microwave-vacuum drying system (MIVAC). Progress report No. 4.** Wear, F.C. (McDonnell Aircraft Co., St. Louis, MO (USA)). 30 Jun 1978. Contract AC02-76CS40031. 52p. NTIS, PC A04/MF A01.

Portions of document are illegible.

Progress in developing a microwave-vacuum system (MIVAC) for drying grain at a commercial grain handling and storage facility is reported. During this period the dryer was redesigned from 48 kW size to 12 kW, components were fabricated and assembled, and performance testing with corn drying was begun. (LCL)

33795 (DOE/OR/05035—T1) **Advanced industrial gas turbine technology readiness demonstration. Quarterly technical progress report No. 12, 1 December 1979-29 February 1980.** (Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA). Government Products Div.). 20 Mar 1980. Contract AC05-76OR05035;AC05-76ET15343. 11p. (FR—13019). NTIS, PC A02/MF A01.

The component technology base required for improved industrial gas turbine conversion efficiency is discussed. Specific goals are to demonstrate the high-pressure compressor and turbine cooling technologies required to achieve industrial gas turbine efficiencies of 34 to 36% simple cycle and 45 to 48% in combined cycle operation while reducing the number of compressor and turbine parts 80% over state-of-the-art units. The approach involves combining some of the most advanced aircraft turbine cooling and high-pressure compressor technology with the simplicity and ruggedness required of industrial engines to achieve not only improved performance, but also increased durability and low initial cost. The program currently consists of two phases. Phase I, which has been completed, included the conceptual definition of an industrial gas turbine capable of meeting the above goals and the aerothermodynamic designs of compressor and turbine component test rigs. Phase II, which is in

progress, consists of component validation testing of the high-pressure compressor and turbine cooling designs which evolved in Phase I. During this quarter, work continued on Phase II, Task III - Compressor Rig Assembly and Test. Assembly of the compressor rig has been completed and final preparation of the rig for transporting to the test facility is in progress.

33796 (NP—24980) **Steam generators for industrial-scale power plants.** Froehlich, P. (Energie- und Verfahrenstechnik G.m.b.H. (EVT), Stuttgart (Germany, F.R.)). 1976. 7p. (In German). NTIS (US Sales Only), PC A02/MF A01.

Computers have enabled the engineer to calculate the behavior of structural components, component groups, and aggregates. As a result, steam generator design has become the sum of various investigations and precalculations, i.e., the product of careful and time-intensive work on the basis of earlier experience. Some typical steam generator types, classified according to the fuels they use, are discussed.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 33760

33797 (CUERS-Report—10) **Cogeneration of electricity in the St. Louis region: industrial potential.** Wallace, N.D. (Southern Illinois Univ., Edwardsville (USA). Center for Urban and Environmental Research and Services). Jul 1979. 30p. Center for Urban and Environmental Research and Services, Southern Illinois Univ., Edwardsville, IL.

Data were obtained from the 17 largest energy users in the St. Louis Standard Metropolitan Statistical Area (SMSA) in order to evaluate their cogeneration potential and their current level of cogeneration activity. The types of companies in the survey include: primary metals, chemicals, glass, petroleum refining, cement, and food processing. The analysis shows a significant unrealized potential for cogeneration of electricity in the St. Louis region. Even without further incentives, a sizable portion of the thermodynamic potential is estimated to be economically viable in both the short- and long-term, but particularly in the latter. Realizing this potential would save significant amounts of energy and also have a favorable impact on the overall air quality of the St. Louis SMSA. There are, however, important barriers to cogeneration that must be overcome, namely: uncertainty over the availability of fuels other than coal; regulatory issues; costs of standby power; and existing state and Federal air-quality standards which discourage many companies at specific sites. The National Energy Act has a favorable impact on the economics of industrial cogeneration but cannot alone be viewed as strong enough to remove the remaining barriers. Several appropriate actions by local, state, and/or Federal authorities which are recommended in order to vastly improve the probability of realizing the economic potential for cogeneration are listed.

33798 **Industrialised plant growing system.** Siddall, R.G. (RCCS Ltd., Ebbw Vale, England). pp 59-60 of Solar energy for industry. London, England; UK-ISES (1978).

From International Solar Energy Society conference; London, UK (27 Feb 1978).

The British Steel Corporation is continually looking for means of conserving energy and the possibilities of putting waste heat to productive use are being explored. One use for waste heat which looks attractive is in horticulture, and particularly to heat greenhouses. Some time ago BSC decided to investigate this possibility and to set up a pilot horticultural scheme. The next step was to use the most advanced horticultural technology, and this led to the decision to build a tower greenhouse along the lines of the Ruthner tower greenhouses set up in Austria and elsewhere, to provide a fully mechanised growing system with continuous production. BSC therefore set up a subsidiary company, Ruthner Continuous Cropping Systems Ltd. (RCCS) to build a pilot tower greenhouse at Ebbw Vale, Wales, using steam from the steelworks, along with a half-acre conventional glasshouse for comparison. The installation is described.

33799 (NP—24997) **Useful heat from waste heat.** (Hauptberatungsstelle fuer Elektrizitaetsanwendung e.V., Frankfurt am Main (Germany, F.R.)). [nd]. 12p. (In German). TIC.

Various methods of heat recovery in buildings, agriculture, and industry are discussed.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 33215, 33219, 33221, 33222, 33223, 33299, 33588

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 33786

33800 (DOE/CS/24216—1) **Energy conserving site design: Greenbrier case study, Chesapeake, Virginia. Final report.** (Greenbrier Associates, Chesapeake, VA (USA)). Apr 1980. Contract AC01-78CS24216. 71p. NTIS, PC A04/MF A01.

A specific case study of project planning for energy conservation for a major planned unit development at the 3000-acre Greenbrier development site in Chesapeake, Virginia, is summarized. The research suggests that very considerable reductions in energy conservation can be achieved within the confines of private-sector land development and residential construction with increased incremental costs of $200.00 to $3150.00 per dwelling unit. It is hypothesized that energy consumption at Greenbrier can be reduced by one-half with an average annual savings of 21,275 kWh per residential unit, using state-of-the-art technology with careful planning and control. This represents an annual savings $750.00 per unit at the current utility rate of 3.5 cents per kWh. These savings can be achieved through reduction in heating and cooling loads and application of more-efficient heating and cooling of the remaining loads. The reduction in loads are achieved by redesign of the land plan to include a higher percentage of south-facing lots, use of vegetation to modify microclimate, decreases in air infiltration, the use of 2 x 6 framing, better insulation, and the use of an insulated slab-on-grade foundation. Further energy savings can be expected by increased efficiencies in mechanical systems used for space heating and cooling and domestic hot water. When applied to the single-family portion of Greenbrier, containing 541 dwelling units, these options reduce the total end-use energy consumption 54.7%. This reduction represents an annual savings of $432,800.00 for an initial capital investment of $1.7 million.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 33732, 33733, 33758, 34062

33801 (ANL/CNSV-TM—36) **Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study.** Bernow, S.S.; McAnulty, D.R.; Buchsbaum, S.; Levine, E. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 106p. NTIS, PC A06/MF A01.

A district-heating system, based on thermal energy from power plants retrofitted to operate in the cogeneration mode, is expected to improve local air quality. This possibility has been examined by comparing the emissions of five major atmospheric pollutants, i.e., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides, from the existing heating and electric system in the City of Boston with those from a proposed district heating system. Detailed, spatial distribution of existing heating load and fuel mix is developed to specify emissions associated with existing heating systems. Actual electric-power-plant parameters and generation for the base year are specified. Additional plant fuel consumption and emissions resulting from cogeneration operation have been estimated. Six alternative fuel-emissions-control scenarios are considered. The average annual ground-level concentrations of sulfur oxides are calculated using a modified form of the EPA's Climatological Dispersion Model. This report describes the methodology, the results and their implications, and the areas for extended investigation. The initial results confirm expectations. Average sulfur oxides concentrations at various points within and near the city drop by up to 85% in the existing fuels scenarios and by 95% in scenarios in which different fuels and more-stringent emissions controls at the plants are used. These reductions are relative to concentrations caused by fuel combustion for heating and large commercial and industrial process uses within the city and Boston Edison Co. electric generation.

33802 (ANL/CNSV-TM—40) **Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles.** Calm, J.M.; Sapienza, G.R. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01.

The CASES computer program is a software package for evaluation of community annual-storage energy system concepts. The software models energy systems that provide space and water heating by cascaded heat pumps and cooling by melting of stored ice. CASES computes thermal demands of individual buildings, aggregates these demands into community demands, models system response, and estimates the overall system costs. The Heat-Pump-Centered Integrated Community Energy Systems (HP-ICES) Project has produced a number of system concepts involving annual-storage cycles for which preliminary application feasibility studies have been performed. More rigorous examination of these concepts as well as detailed simulation and analysis of application feasibility would increase understanding of their potential. The CASES software was considered for these purposes, but was found unsuitable for evaluation of HP-ICES concepts and their application feasibility. No alternative software has been identified which will provide these capabilities, and extensive effort would be required to upgrade CASES for the intended concept evaluations.

33803 (CONF-790401—) **District-heating/cogeneration symposium.** (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 303p. NTIS, PC A14/MF A01.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

The symposium presented results of a series of studies on the feasibility of a large-scale hot-water district-heating system for the Minneapolis-St. Paul area. A separate abstract was prepared for each of 10 papers included in the proceedings. One paper was processed earlier (see EAPA 5: 3291).

33804 (CONF-790401—, pp 13-32) **European district-heating experience with focus on Uppsala hot-water district-heating system.** Nyman, H. (Uppsala District Heating System, Sweden). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

District heating using cogenerated thermal energy from small station power plants dates from the turn of the century in both the United States and Europe. Because until recently the US has had an abundance of fuel resources, the need to improve and expand district heating has not been critical. Sweden, which had large hydroelectric power resources but no domestic fuel resources, began district heating after the second world war. Urbanization and increased energy use in buildings resulted in increased demand for oil. Today, three million of Sweden's eight million people live and work in buildings heated by district heating. Uppsala, a university city 40 miles north of Stockholm, started district heating in the beginning of the 1960's. The city expected extensive development and wanted, in the long term, to provide the inhabitants with electricity and district heating from a cogeneration plant. Many problems had to be solved to introduce district heating in an old city. The load grew rapidly and, in 1974, a cogeneration plant was put in operation. This paper describes the reasons for district heating in Sweden and the experience from the Uppsala system.

33805 (CONF-790401—, pp 35-43) **Overview of Twin Cities district-heating studies.** Visness, R.D. (Minnesota Energy Agency, St. Paul). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

The Minnesota Energy Agency believes the decision to implement hot-water district-heating will set one of Minnesota's most-significant energy directions. The factors affecting the decision include technical, economic, and institutional issues. Any decision to implement a district-heating system involves the local utility, local government, the local business community, and the state. These parties need a sufficiently detailed common data base at each step of the process so that decisions can be made. The purpose of the studies in the Twin Cities is to develop such a data base. Studies underway in the Twin Cities are grouped into four categories: technical and economic feasibility, siting, and institutional and environmental issues. The purpose of the studies are presented along with a rough outline of results where these are available. The paper also contains (1) suggestions on the types of studies needed in the next phase of the project, and (2) an organization structure under consideration.

33806 (CONF-790401—, pp 45-106) **Feasibility of a large-scale cogeneration/hot-water district-heating system in the Twin Cities.** Margen, P.; Larsson, K.; Cronholm, L.A.; Marklund, J.E. (Studsvik Energiteknik AB, Nykoeping, Sweden). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

A study was made of the feasibility and economics of introducing district heating for a large part of the urban area of Minneapolis and St. Paul. A regional hot-water system following modern European practice would be built to cover the entire area and would be fed by heat from converted turbines at the existing coal-fired Riverside and High Bridge power stations in Minneapolis and St. Paul. Toward the end of the 20-y period studied, one or two new cogeneration units would be introduced. Peak loads would be taken by oil-fired peak-load boilers. Thus reject heat, coal, and, to a smaller extent, oil would replace the present space-heating fuels - natural gas and light oil. The conclusions reached are that the concept is entirely feasible technically, has great fuel-conservation value, benefits the environment, and is economically sound with an appropriate financing system.

33807 (CONF-790401—, pp 109-156) **Twin Cities institutional issues study: cogenerated hot-water district heating.** Leas, R. (Minnesota Energy Agency, St. Paul). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

Community district heating, utilizing hot water produced through electrical/thermal cogeneration, is seen as an integral part of Minnesota's Energy Policy and Conservation Plan. Several studies have been conducted which consider the technical and institutional issues affecting implementation of cogenerated district heating in the Minneapolis/St. Paul Metropolitan Area. The state of the technical art of cogenerated hot-water district heating is assumed to be transferable from European experience. Institutional questions relating to such factors as the form of ownership, financing, operation, regulation, and product marketability cannot be transferred from the European experience, and have been the subject of an extensive investigation. This paper discusses the form and function of the Institutional Issue Study, and some of the preliminary conclusions and recommendations resulting from the Study.

33808 (CONF-790401—, pp 159-180) **St. Paul district-heating study.** Jaehne, H. (Northern States Power Co., Minneapolis, MN). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

Northern States Power Company is studying the commercial and industrial area of downtown St. Paul to determine the technical and economic feasibility of establishing a major district-heating system. An initial evaluation was made to determine the heating medium to be used. Medium-temperature hot water at 300°F was selected. A market survey and analysis examined the potential heating, cooling, and process demand of the study area. A comprehensive energy questionnaire was completed for all potential customers and an analysis based on economic payback determined the thermal energy demand up to the year 2000. A preliminary distribution piping design and layout was completed to serve the market area. Local geographical and utility information was used to develop capital and operating costs for the system. A financial analysis will assess the economic feasibility of the system using conventional utility methods. The payback period approach will be used as a measure of financial feasibility. The study is presently in a draft form and is being revised to reflect comments received from interested parties.

33809 (CONF-790401—, pp 183-203) **Energy sources for a Twin Cities hot-water district-heating system.** Englesson, G.A. (United Engineers and Constructors, Inc., Philadelphia, PA). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

A number of energy sources using both existing and new technology are being considered for a district-heating system in the Twin Cities. Since planning, design, and construction of new steam/electric generating stations can take eight to ten years, an interim solution, modifications of existing steam-electric stations to cogeneration is planned. Detailed evaluation of the design and modifications needed to convert three of the four operating units at the High Bridge Stations completed. This evaluation indicated that the design, procurement, and construction of modifications of Units 3, 5, and 6 can be achieved within two years at a cost of nine million dollars. After modification, the station will have the capability to simultaneously provide 440 MW(t) and 224 MW(e) at the maximum steam extraction for district heating. The current maximum electric capacity of these units, 321 MW(e), will be reduced during the heating season, but will be available near its maximum during the peak-electrical-demand seasons. A study is underway to develop the costs of and projected schedules for new small- and medium-sized coal-fired cogeneration plants designed to use either existing or new technology. These costs will be compared with those developed for the High Bridge modification. One other energy source evaluation using the Consolidated Nuclear Steam Supply (CNSS) was completed and will further amplify the comparison.

33810 (CONF-790401—, pp 205-218) **Effects of a district-heating system on annual urban sulfur dioxide emissions.** Murphy, B.D. (Oak Ridge National Lab., TN); Schlatter, E.C., Raridon, R.J.; Stockdale, W.G. Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

A system of district heating with cogeneration proposed for the Minneapolis-St. Paul (Twin Cities) area is expected to improve local air quality. The validity of this statement is tested by comparing the sulfur dioxide (SO_2) emissions of the present system with those from the various pollutant-emission sources at a future date when district heating with cogeneration might be in operation. The consequent pollutant-loading situation both with and without the planned system is assumed. The current kinds and distribution of building structures in the Twin Cities are used. However, future fuel use is projected. The estimation of the SO_2 contributions from the various pollutant source categories is discussed. The annual SO_2 loading is computed using conventional urban-diffusion-modeling techniques. This report of ongoing work speculates on the importance of the different components of the source inventory and how they would contribute to pollutant loading when different scenarios are studied.

33811 (CONF-790401—, pp 221-243) **Conversion of existing buildings in the Twin Cities to a hot-water system.** Sundberg, R.E. (Minnesota Energy Agency, St. Paul). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

This report presents the results of a study of the costs and techniques required to convert existing buildings in Minneapolis and St. Paul to use 300°F hot-water district heating. The buildings and heating systems in the high-density areas in both downtown Minneapolis and St. Paul were surveyed, and a computer data base was assembled. A total of 280 buildings was surveyed, representing a peak thermal load of about 400 MW. Techniques were developed to convert existing heating systems to use 300°F hot-water district heating. The return-water temperature was selected for minimum cost and maximum power yield at the cogeneration plant. The cost of converting heating systems in existing buildings to district heating was developed by two separate approaches: (1) by theoretical cost studies of heating systems, and (2) by engineering cost studies of heating systems in existing buildings. In the first approach, cost estimates were generated by designing conversion systems for a range of building sizes for each of the major types of heating systems. In the second approach, engineering cost studies were done for five buildings that were representative of the buildings in the study area. The heating-system conversions of the five buildings were designed for three return-water temperatures to determine the effect on conversion costs of varying the water flow rate and the difference between the water-supply temperature and return-water temperature. The conversion costs for the three return-water temperatures can be used to estimate the optimum return-water temperature. Conversion costs were determined from detailed bids submitted by a heating, ventilating, and air-conditioning contractor.

33812 (CONF-790401—, pp 245-254) **Hot-water district-heating in Minnesota cities.** Barnes, M.H. (KVB, Inc., Minneapolis, MN). Oct 1979.

From District heating coal generation symposium; Minneapolis, MN, USA (2 Apr 1979).

The first phase of the DOE-sponsored district-heating demonstration program in Minnesota was a survey of the existing thermal power plants and their potential for providing district heating. This survey defined probable distribution system layout, costs, and power-plant-retrofitting recommendations. From this survey, three sites - Red Wing, Fergus Falls, and Moorhead - were selected as best for the development of district heating.

33813 (ORNL/HUD/MIUS—53) **Application of Modular Integrated Utility Systems (MIUS) concept as a strategy for urban rehabilitation and redevelopment.** Gant, R.E. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 69p. NTIS, PC A04/MF A01.

The potential role of the Modular Integrated Utility System (MIUS) as a strategy for implementing urban redevelopment and rehabilitation objectives is assessed. Major environmental, utility infrastructure, and national policy constraints to urban redevelopment efforts are examined. The emphasis is on high-density urban areas of major cities where planned redevelopment and rehabilitation efforts could be seriously impeded by lack of existing utility infrastructures, inadequate service, and restrictive environmental legislation. The current status of air quality, potable water quality, regional solid waste disposal capacity, and capabilities of liquid waste treatment systems is described for the nation's 100 largest metropolitan areas. The MIUS concept is evaluated as a community development strategy capable of complying with environmental regulations, upgrading utility services, and supporting high-density urban development. Examples are developed which indicate that the MIUS concept could be used in high-density residential and commercial areas to permit development without major disruptions to surrounding areas. A case study of Philadelphia, Pennsylvania was undertaken to characterize the role of MIUS in an existing urban environment. Housing patterns, planned redevelopment efforts, concerns for community ethnic integrity, high utility costs, and a proposed metropolitan district heating system make the MIUS concept attractive for Philadelphia's urban strategy.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 33357, 33362

33814 (NP—25012) **Organic recycling in agriculture.** (Ministry of Agriculture and Irrigation, New Delhi (India). Fertiliser Div.). 1979. 49p. NTIS (US Sales Only), PC A03/MF A01.

Portions of document are illegible.

Some selected aspects of the importance of recycling of organic wastes for agriculture and biological fixation of nitrogen are preseted. A balanced use of organic and inorganic fertilizers can permit sustained production in the soils of India. Recycling of organic wastes can also help meet the rural fuel needs, reduce deforestation, and encourage clean and healthful living. Supplemental papers included are: pattern of central subsidy followed under five-year plan for different sub-schemes of the local manurial resources scheme; organic recycling; use organic materials to increase crop production; strategy to meet the drought situation-increased conservation of moisture and plant nutrients through organic fertilization, legume cropping,and use of bio-fertilizers; Janata biogas plants; operation of a gobar gas plant is easy; prepare compost from water hyacinth; sewage/sullage utilization for agricultural production; blue green algae-a potential source for raising rice yields; rhizobial inoculation for higher pulse production; bio-fertilizers in rice cultivation; and meeting of energy fuel energy and fertilizer needs of the rural sector through biogas system.

33815 **New technological developments in processing solid waste to energy.** Sherwin, E.T.; Nollet, A.R. New Castle, DE; AENCO, Inc. (1980). 25p. (CONF-800352—5).

From 7. energy technology conference and exposition; Washington, DC, USA (24 Mar 1980).

The state-of-the-art in production of energy from municipal solid waste outlining relative advantages, limitations, and economics of various systems is briefly reviewed including mass-burning versus RDF in spreader-stoker fired boilers; suspension-firing of RDF; pulverized fuel; pelletized fuels; and gaseous fuels generated by pyrolysis processes. A new system for processing solid waste for resource recovery separates the incoming waste by air-classification as the first processing step; conventional systems shred as the first processing step. This new system, originally developed to guard against shredder explosions, has the following supplemental advantages: produces a refuse-derived fuel (RDF) having higher heating values and less ash than conventional systems; and reclaims waste paper which can be used as paper-making furnish, utilizing current beneficiating and cleaning techniques. Production of paper from virgin materials requires 20 to 30 million Btu per ton of paper - versus 10 million Btu when waste paper is utilized as furnish. A new system proposed for storage, handling, and feeding refuse-derived fuel to large suspension-fired boilers is examined. This system proposes coarse shredding only of the light fraction at the solid waste processing plant; shipment in compactor trailers; storage in the same trailers; fine-shredding near the boiler; and air transport from the shredders using material handling fans injecting directly into the boilers. This system provides more efficient operation at less capital cost than systems utilized to date.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 33781

33816 (NCEI—0017) **Directory of North Carolina energy-resource personnel.** (North Carolina Energy Inst., Research Triangle Park (USA)). Apr 1980. 73p. NTIS, PC A04/MF A01.

This directory is a statewide inventory of university, research-institution, and professional persons who have specific expertise and interest in the energy field. Its purpose is to assist local governments in obtaining technical assistance in all areas of energy technology. All listings in the directory are by state region and, within each region, all persons are identified by professional backgrounds: physical scientists, biological scientists, social scientists, engineers (including architects), and others. Under each professional background, areas of expertise and interest are identified: advanced energy systems, conventional energy systems, energy conservation, energy environmental impact, policy development, public awareness, and solar.

33817 (ORAU—170) **Training migrant and seasonal farmworkers for energy-related occupations.** Weseman, M. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Tranining Div.). Jul 1980. Contract AC05-76OR00033. 46p. NTIS, PC A03/MF A01.

The US Department of Energy (DOE) and US Department of Labor (DOL) have cosponsored a number of demonstration programs to train economically disadvantaged migrant and seasonal farmworkers for energy-related technical and skilled occupations. This descriptive study examines the first DOE/DOL demonstration to determine the impact of training on participants' subsequent labor-force activity and the effectiveness of the program in meeting the needs of this target group. Analysis of participants' employment and wage rates before and after training indicates favorable outcomes as wages and the number employed increased significantly. All selected subgroups experienced substantial employment-status gains with women reporting the largest increases. Post-training wages of all subgroups were approximately double those before training with women, nonwhites, and high-school graduates reporting the largest increases. Data on farmworkers were compared to those of other clients enrolled in the same program under the Comprehensive Employment and Training Act (CETA), and a national sample of CETA participants enrolled in vocational-training programs. In general, the farmworkers reported employment-status gains similar to the national CETA sample but lower than the other CETA participants enrolled in the same program. The farmworkers' wage gains were significantly greater than those reported by the two comparison groups. Apparent key factors contributing to the success of the

program include the farmworkers' desire to leave agricultural labor, their willingness to relocate to accept employment, the existing network of employers developed by the training program, and the program's ability to provide needed supportive services.

33818 Attitudes toward energy use and policy in New Mexico. Eastman, C.; Stevens, T. Las Cruces, NM; New Mexico State University (1978). 17p. (NP—25031).

A statewide sample of New Mexicans were interviewed during the summer of 1977 to determine perceptions of the energy situation, willingness to alter consumption in response to higher prices, and energy policy preferences. Respondents perceived the energy situation as serious, long-term, and a potential threat to national security. They also perceived Americans as wasteful of energy, but the respondents indicated they could reduce energy consumption by an averge of only some 11 to 18% if prices doubled over 1977 levels. For conservation policies, respondents preferred inexpensive incentives to compulsory regulations or rationing. They preferred both foregoing options to higher prices. Among supply policies, solar and wind development was preferred to increased coal or petroleum production. More nuclear development was preferred only to expanded imports.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 33848

SPARK-IGNITION

REFER ALSO TO CITATION(S) 33847

DIESEL

33819 (TE—4257-72-80) **Status report on diesel organic-Rankine compound engine for long-haul trucks.** (Thermo Electron Corp., Waltham, MA (USA)). Oct 1979. Contract AC02-76CS52832. 33p. (CONF-791082—2). NTIS, PC A03/MF A01.

From DOE automotive technology development contractors coordination meeting; Dearborn, MI, USA (23 Oct 1979).

A completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine, which operates on the exhaust heat from the diesel engine has been developed and demonstrated. The prototype compound engine is built around a standard Mack Truck diesel engine, and the waste heat recovery system is a Thermo Electron organic-Rankine bottoming cycle system incorporating a turbine expander delivering power to the diesel engine drive train. The most attractive use of the diesel organic-Rankine compound engine is in large, heavy-duty trucks for long-distance hauling. Here the engine load and speed requirements are nearly constant over a large portion of the operating hours, and high mileages are accumulated. Thus, the potential fuel savings is sufficient to justify the added cost of a bottoming cycle system. Based on engine dynamometer tests to date, the addition of an organic-Rankine bottoming cycle to a long-haul diesel truck can improve the fuel economy by 15% over a typical duty cycle. Utilizing a chassis-mounted dynamometer, baseline performance testing was completed on the compound engine installed in the truck. Checkout road tests were then completed at TECO prior to delivery of the truck to Mack Truck's Engineering Development and Test Center for further testing. Over 600 hours of endurance testing have been completed to date on a second compound engine installed on a facility dynamometer. Design of a new integrated power conversion unit is nearing completion and installation drawings are being prepared.

33820 (TE—4257-207-80) **Status report on diesel organic Rankine compound engine for long-haul trucks.** Koplow, M.D.; DiNanno, L. (Thermo Electron Corp., Waltham, MA (USA)). 1980. Contract AC02-76CS52832. 56p. NTIS, PC A04/MF A01.

A Class 8 truck has been equipped with a completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine, which operates on the exhaust heat from the diesel engine. The prototype compound engine is built around a standard Mack Truck diesel engine, and the waste heat recovery system is a Thermo Electron organic Rankine bottoming cycle system incorporating a turbine expander, delivering power to the diesel engine drive train. The addition of an organic Rankine bottoming cycle to a long-haul diesel truck can improve the fuel economy by 15% over a typical duty cycle. Installation of this type of compound engine in all of the 490,000 Class 7 and 8 heavy-duty trucks projected to be engaged in long-distance hauling this year (1980) would save 1.43 billion gallons of diesel fuel annually, or an average fuel savings of 3000 gallons per truck. Work performed from October 1979 to April 1980 and the program developments and testing results achieved to date are summarized. A fuel economy evaluation of the prototype truck during over-the-road operation is presented with other performance results acquired during dynamometer testing of the vehicle. Energy policy and economic issues relevant to this program are discussed in the Appendix.

TURBINE

33821 (DOE/NASA/0008—80/11) **Regenerator matrix physical property data.** Fucinari, C.A. (Ford Motor Co., Dearborn, MI (USA). Research Staff). May 1980. Contract AI01-77CS51044. 52p. (NASA-CR—159854). NTIS, PC A04/MF A01.

In order to arrive at an optimum regenerator design for a given application the matrix fin geometries being considered must be completely characterized. Regenerator performance and durability, which are two diverse design areas, are both highly dependent on the matrix fin geometry selected. Based on the extensive engine durability testing at 800°C and 1000°C in the Ford 707 gas turbine engine, the three most promising regenerator matrix materials have been completely characterized. Summaries are the important design parameters for these matrices in the following categories: Aero-Thermodynamic Properties - The standard and an alternate form of performance characteristics allow the designer to estimate performance for a fixed size exchanger or to determine the size required to attain specified performance objectives; Matrix Physical Properties - Thermal expansion, modulus of elasticity and modulus of rupture are the important parameters required to estimate the thermal stress capacity of a given design for specified operating conditions; Resistance to Chemical Attack - Once the regenerator is designed properly to have sufficient thermal stress capacity, the matrix material must be resistant to the exposure of corrosive agents such as sulfuric acid in the engine exhaust or the presence of sodium in the inlet air or fuel system; and Thermal Stability - The upper temperature limit of the matrix material must be determined to ensure dimensional stability will be acceptable. Excessive dimensional change can lower the thermal stress capacity of a given design.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

33822 (DOE/NASA/1040—17) **Preliminary results from a four-working space, double-acting piston, Stirling engine controls model.** Daniele, C.J.; Lorenzo, C.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-77CS51040. 17p. (CONF-800806—38). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

A four-working space, double-acting piston, Stirling engine simulation is being developed for controls studies. The development method is to construct two simulations, one for detailed fluid behavior, and a second model with simple fluid behavior but containing the four working space aspects and engine inertias, validate these models separately, then upgrade the four-working space model by incorporating the detailed fluid behavior model for all four working spaces. The single working space (SWS) model contains the detailed fluid dynamics. It has seven control volumes in which continuity, energy, and pressure loss effects are simulated. Comparison of the SWS model with experimental data shows reasonable agreement in net power versus speed characteristics for various mean pressure levels in the working space. The four-working space (FWS) model was built to observe the behavior of the whole engine. The drive dynamics and vehicle inertia effects are simulated. To reduce calculation time, only three volumes are used in each working space and the gas temperatures are fixed (no energy equation). Comparison of the FWS model predicted power with experimental data shows reasonable agreement. Since all four-working spaces are simulated, the unique capabilities of the model are exercised to look at working fluid supply transients, short circuit transients, and piston ring leakage effects. The FWS model has been upgraded by using the detailed SWS model for each of the four working spaces. Currently the detailed FWS model is being reworked to reduce the amount of calculation time per cycle.

RANKINE CYCLE

REFER ALSO TO CITATION(S) 33819, 33820

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 33789

33823 (DOE-tr—228) **Load conditions for a storage battery, three-phase voltage inverter and asynchronous traction motor during acceleration of an automobile at set intensity.** Pavlushkov, B.E. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 8p. NTIS, PC A02/MF A01.

In the electric drive system of an electric automobile (EA) the operating conditions for the storage battery (SB), self-contained voltage inverter (SI) and asynchronous traction motor (ATM) are determined to a significant degree by the pulse nature of the electromagnetic processes accompanying the formation and regulation of a three-phase voltage in accordance with the accepted laws for control of the ATM. This factor must be fully considered when calculating the currents of the SB (iδ) and SI rectifiers (i/sub r/) and the current, magnetic flux and torque of the ASM (i_1, psi_1, m). A mathematical model is developed which permits the calculation of instantaneous values of these electromagnetic values as a function of time, voltage, voltage frequency and motor rotor rpm's.

33824 (DOE-tr—229) **Energy aspects of designing electric automobiles and electrical transmissions for them.** Kaveshnikov, V.M.; Semikov, Yu.I. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 10p. NTIS, PC A02/MF A01.

At present, there is a great number of various designs in the world of electric automobiles in both passenger (light) models and in low-capacity van models. A number of these designs have been placed in production and some electric automobiles have been and are being produced in small series and lots, but they are all designed chiefly for operation under urban conditions. It is obvious that this situation will continue in the near future. This report examines only passenger automobiles. The purpose of the report is to describe models for which research, development and production would be advisable at present and in the near future with respect to technical, economic, and social qualities.

33825 (DOE-tr—230) **Asynchronous drive for an electric automobile under slip conditions.** Izosimov, D.B. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 7p. NTIS, PC A02/MF A01.

The use of an asynchronous electric motor with a short-circuited rotor to drive an elastic automobile is promising for a number of reasons. It is sufficient to point out the good power and performance specifications of an asynchronous motor; these are due to the simplicity of its design and the absence of sliding contacts, which provide high reliability, safety and the possibility for designing an individual drive for the motor-wheel from an onboard power source (inverter). The structure of the control system of such a drive is discussed.

33826 (DOE-tr—231) **Methods for perfecting nickel-zinc storage batteries for the power plants of electric automobiles.** Lidorenko, N.S.; Dmitrenko, V.E.; Baulov, V.I. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 6p. NTIS, PC A02/MF A01.

Road tests on an electric automobile showed that Ni-Zn batteries provide a range of 90 to 120 km per charge-discharge cycle depending on the average speed of the vehicle. As was previously noted, these batteries have specific electrical characteristics which are roughly double those of lead-acid storage batteries. Analysis of the results of bench tests of test models of storage batteries and tests of three sets of batteries in an electric automobile made it possible to determine methods for further perfecting nickel-zinc storage batteries for the power plants of electric automobiles. These methods are discussed.

33827 (DOE-tr—232) **dc thyristor-capacitor converter for an electric automobile.** Bulatov, O.G.; Tsarenko, A.I. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 7p. NTIS, PC A02/MF A01.

At present, the most widely used electric automobiles are those equipped with dc motors. As a rule, pulse-width thyristor regulators with LC-circuit switches are used to smoothly regulate the shaft torque of a dc motor. The required mechanical characteristics in such drives are ensured by introducing current feedback. An additional compilation of the control system of the converter with the LC-circuit switch is generally necessary for starting, as well as for the design of electric drives with two-speed control. The operational reliability of the electric drive is significantly dependent on the operational reliability of the control system. The relatively low converter modulation frequency (no more than 400 to 600 Hz) leads to an increase in the weight and dimensions of the input and output smoothing filters. The use of a high-frequency converter with series capacitor switching for regulation of a dc motor is proposed. Also the results of a comparison of the proposed converter with series capacitor switching and a converter with LC-circuit switching are presented. Basic diagrams of the power side of the compared converters with respect to the use of them in an electric automobile are provided.

33828 (DOE-tr—233) **Builtin asynchronous electric motor for a light passenger automobile motor-wheel.** Kazanskii, V.M.; Zonov, V.N. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 7p. NTIS, PC A02/MF A01.

The most significant advantages of asynchronous electric motors over other types of electric motors are their high reliability and low weight, dimensions and cost, which is very important for vehicle propulsion plants. The use of asynchronous electric motors in electric transmissions simplifies maintenance due to the absence of a sliding contact, simplifies self-regulation of the difference in wheel speeds when cornering and makes it possible to produce a better design for the wheel and electric motor due to the smaller size of the latter. When electric motors are used as the wheel drive in vehicles an intensive desire can be seen to provide an arrangement for the system with which the electric motor will be built into the wheel hub and the structural elements of the wheel and motor will form a single unit. These designs have been successfully realized in the motor-wheel chassis of heavy trucks and self-propelled trolleys. The advantages and disadvantages of the use of the motor-wheel type of design in a light passenger automobile are discussed.

33829 (DOE-tr—235) **Research and optimization of static operating conditions for battery-powered electric automobiles.** Varpetyan, V.S.; Tarasyan, A.P. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 7p. NTIS, PC A02/MF A01.

The overwhelming majority of modern electric automobiles is produced with series-wound dc motors (SWM) powered by lead-acid storage batteries (SB) through thyristor pulse-width converters (PWC). In addition to the known power advantages of a drive with an SWM, the use of it in an electric automobile involves certain circuit complications in the power circuits for pulse-regenerative braking and in the traction modes with reduction of the SWM magnetic flux. Despite the traditional use of SWMs as traction engines for electric automobiles, it is also possible to achieve optimum control of the operational modes of the self-contained system. Typical features of battery-powered electric automobiles are the presence of a significant mutual influence between the characteristics and indicators of the SB, PWC, drive motor (M) and mechanical reducing gear (R) and a change in the output figures for the system depending on the level of charge. Research on the energy consumption and on optimum control of an electric automobile according to the SB-PWC-M-R is discussed.

33830 (DOE-tr—237) **Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control.** Chekhovoy, Yu.N. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 8p. NTIS, PC A02/MF A01.

Due to the rapid decrease in oil reserves in many nations of the world, interest has grown in recent years in electric automobiles, i.e., automobiles with electric drive powered by storage batteries. The present report examines one possible design, in which the voltage from the storage battery (SB) is converted by a power pulse converter (PPC) into a pulse train modulated in frequency and width. Here, as the primary controlling influence, pulse width modulation (PWM) serves to regulate the mean voltage applied to the motor armature, while pulse-frequency modulation (PFM) is used as an additional optimizing influence.

33831 (DOE-tr—238) **Self-contained inverters with pulse-width voltage regulation for an ac electric drive in an electric passenger automobile.** Labuntsov, V.A.; Zheglov, V.A. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 10p. NTIS, PC A02/MF A01.

The use of traction asynchronous motors (TAM) with frequency control in place of dc motors is a promising trend in the development of electric automobiles. For this reason, at present both in the USSR and abroad, work is under way to develop thyristor inverters which will make it possible to regulate the speed and electromagnetic moment of a TAM powered from a non-regulated dc source, a storage battery. Under frequency control of a TAM, in order to form the required traction characteristics of the electric automobile when accelerating, moving at reduced speeds, etc. it is necessary to regulate both the frequency and value of the voltage applied to the motor. The use of inverters with PWR in an electric automobile makes it possible to eliminate a separate voltage regulator in the dc circuit from the main power circuit system. At the same time, PWR makes it possible to use simpler circuits for the inverters and systems for controlling them and to operate at a lower switching frequency than when forming the voltage curve and regulating its value by the PWM method. The possibility is examined for controlling the speed of an electric automobile with a TAM by using self-contained voltage inverters (SCVI) with pulse-width regulation of

the output voltage while changing its frequency within a broad range, which is one of the primary requirements for an electric drive in an electric automobile.

33832 (DOE-tr—239) **Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles.** Dilanyan, E.M.; Momdzhyan, A.A. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 8p. NTIS, PC A02/MF A01.

A method is examined for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles (EA) with capacities of 0.5 to 1.2 tons depending on the requirements imposed by the production assignment for the specifications of the EA being designed and operating conditions.

33833 (DOE-tr—240) **System of regulating an electric automobile with an induction traction motor.** Zverev, G.A.; Luvishis, A.L.; Koltsova, N.D. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 8p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The development of the theory of induction frequency control thyristor traction drive and the progress in macro- and microelectronics make it possible to view a drive of alternating current with induction traction motor in the role of a likely prospect, along with the traditional direct current drive, for an electric automobile. The advantages of applying an alternating current drive are connected with the advantages of applying induction short-circuit motor in the traction role, the chief ones of which are low labor requirements in manufacturing and the virtual absence of any service requirements, the overload capacity in a wide range of speeds, and their small dimensions and weights. A drive for electric automobiles of various types with an overall weight of 3 tons and a weight carrying capacity of 0.5 tons is examined. The drive has been installed on 20 trucks and 6 mini-electric busses which are in operation in the city of Moscow.

33834 (DOE/CS—0178(Rev.1)) **Electric and hybrid vehicle self-certification and verification procedures: Market Demonstration Program.** (Department of Energy, Washington, DC (USA)). Mar 1980. 17p. NTIS, PC A02/MF A01.

The process by which a manufacturer of an electric or hybrid vehicle certifies that his vehicle meets the DOE Performance Standards for Demonstration is described. Such certification is required for any vehicles to be purchased under the Market Demonstration Program. It also explains the verification testing process followed by DOE for testing to verify compliance. Finally, the document outlines manufacturer responsibilities and presents procedures for recertification of vehicles that have failed verification testing.

33835 (DOE/JPL/955283—1) **Mass-reduction effort of the electric and hybrid vehicle.** Freeman, R.B.; Jahnle, H.A. (Budd Co., Fort Washington, PA (USA). Technical Center). Mar 1980. Contract NAS-7-100-955283. 198p. (JPL—9950-374). NTIS, PC A09/MF A01.

Weight reduction, cost competitiveness, and elimination of the intrusion beam resulted from the redesign and fabrication using composite materials of the door outer panel and intrusion beam from a 1977 Chevrolet Impala. The basis of the redesign involved replacing these two steel parts with a single compression molding using the unique approach of simultaneously curing a sheet molding compound outside panel with a continuous glass-fiber intrusion strap. A weight reduction of nearly 11 pounds per door was achieved. Additional weight savings are possible by taking advantage of the elimination of the intrusion beam to design thinner door structures. The parts-consolidation approach allows the composite structures to be cost-competitive with the original steel design for both the lower-production car models and for the near- to mid-term production contemplated for electric and hybrid vehicles using current state-of-the-art composite production techniques. In addition to the design, prototype fabrication, and costing phases, two appendices containing materials description, properties, and compression-molding production requirements are included.

33836 **Battery clamping and retention.** Alt, R.D.; Williams, A.B.; Pauly, E.L. (to General Motors Corp.). US Patent 4,169,191. 25 Sep 1979. Filed date 11 Sep 1978. 4p.

A low-profile and versatile battery-retaining assembly used to secure a plurality of batteries for an electric vehicle is described. The batteries are arranged in close proximity to one another in a generally rectangular matrix of two or more, and each has recessed hold-down portions located on opposite lower edges. A perimeter frame extends about the battery arrangement and includes vertical and horizontal edge portions. Elongated retainer members extend between the batteries, each having enlarged portions that project into the recessed hold-down portions of the batteries. The elongated retainer members engage the frame with their ends extending into elongated slots; this arrangement permits self-adjustment with respect to the position relative to the frame ends. Thus, variations in battery dimension are automatically accommodated.

HYBRID SYSTEMS

33837 (DOE-tr—236) **Selection of power ratios in the electrical equipment of an electric automobile with combination-type power plant.** Momdzhyan, A.A. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 6p. NTIS, PC A02/MF A01.

Due to the absence of a generally accepted method for selecting the basic parameters of power sources in electric automobiles with combination-type power plants, an algorithm was developed for solving the problem on a computer. Existing analytical dependences for power design for vehicles, equations for electric traction motors and SP equations obtained on the basis of the results of experimental research, as well as internal combustion engine equations, also obtained on the basis of results of experimental research, were used in the solution.

33838 (DOE-tr—227) **Hydrogen-air electrochemical energy installation for electric automobiles.** Lidorenko, N.S.; Muchnik, G.F.; Karichev, Z.R.; Morozov, V.P. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 5p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The technical aspects of hydrogen-air electrochemical energy installations as sources of energy for urban electric automobiles are discussed. It is concluded that these installations are theoretically feasible. (LCL)

EMISSION CONTROL

CARBON MONOXIDE

33839 (DOE/NASA/1040—16) **Gas phase oxidation downstream of a catalytic combustor.** T'ien, J.S.; Anderson, D.N. (Case Western Reserve Univ., Cleveland, OH (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract AI01-77CS51040. 14p. (NASA-TM—81551; CONF-7903134—1). NTIS, PC A02/MF A01.

From 13. middle atlantic regional meeting of the American Chemical Society; West Long Branch, NJ, USA (19 Mar 1979).

The objective of the experiments reported here was to determine what effect the length available for gas-phase reactions downstream of the catalytic reactor has on the emissions of CO and unburned hydrocarbons. A premixed, prevaporized propane/air feed to a 12-cm-dia catalytic-reactor test section was used. The catalytic reactor was made of four 2.5-cm-long monolithic catalyst elements. Four water-cooled gas-sampling probes were located at positions between 0 and 22 cm downstream of the catalytic reactor. Measurements of unburned hydrocarbons, CO, and CO_2 were made. Tests were performed with an inlet-air temperature of 800°K, a reference velocity of 10 m/s, pressures of 3 and 6 x 10^5 Pa, and fuel-air equivalence ratios of 0.14 to 0.24. For very lean mixtures, hydrocarbon emissons were high and CO continued to be formed downstream of the catalytic reactor. At the highest equivalence ratios tested, hydrocarbon levels were much lower and CO was oxidized to CO_2 in the gas-phase downstream. To achieve acceptable emissions, a downstream region several times longer than the catalytic reactor could be required.

HYDROCARBONS

REFER ALSO TO CITATION(S) 33839

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 33359, 33415, 33417, 33430

33840 (CONF-790520—, pp I.7.1-I.7.13) **Ethanol/gasoline blends as automotive fuels.** Allsup, J.R.; Eccleston, D.B. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

An experimental study of gasoline and 10% ethanol/90% gasoline blends was made using five late-model vehicles operated on a climate-controlled chassis dynamometer. Data were obtained to permit comparisons of fuel economy, emissions, and other significant operational characteristics observed in tests with the two fuels. Volumetric fuel economy was shown to be slightly decreased while energy economy was slightly increased using the ethanol/gasoline blend. Compared with the results using base gasoline, the use of the ethanol/gasoline blend had no adverse effect upon regulated emis-

sions at test temperatures within the range 20° to 75° F; at 100° F there were minor increases in emissions using the ethanol/gasoline blends. Addition of ethanol at 10% concentration generally either had no effect or only slight effect on unburned hydrocarbon; an exception was noted for 100° F at which temperature unburned hydrocarbon from the blend was increased significantly over that found with the base fuel. Road octane quality of the ethanol/gasoline blend was increased by about 3.5 numbers over the base fuel.

33841 (CONF-790520—, pp I.9.1-I.9.14) **50,000 mile methanol/gasoline blend fleet study: a progress report.** Stamper, K.R. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

Seven current production automobiles are being used in a fleet study to obtain operational experience in using 10% methanol/90% gasoline blends as an automotive fuel. Data from chassis dynamometer tests (run according to the 1975 to 1978 Federal test procedure) have been obtained, showing fuel economy and exhaust emissions of carbon monoxide, oxides of nitrogen, unburned fuel, methanol, and aldehydes. These data are shown for each of the vehicles when operated on the 10% methanol blend, and on unleaded low octane Indolene. Chassis dynamometer tests were run at 5000-mile intervals during the 35000 miles accumulated on each of the four 1977 model-year vehicles and at 5000 and 10,000 mile accumulation levels for each of the three 1978 model-year vehicles. These data show an average decrease in volumetric fuel economy (is congruent to 5%) and a reduction in carbon monoxide emissions associated with the use of the 10% methanol blend. Exhaust emission deterioration factors are projected from the Federal test procedure urban cycle data. The most severe driveability problems that have been encountered thus far into the program are related to operating on a phase separated fuel and materials compatibility problems with an elastomer in the air-fuel control hardware of one vehicle.

33842 (CONF-790520—, pp II.20.1-II.20.10) **Alcohol/gasoline reliability fleet tests: a US Federal project.** Ecklund, E.E.; White, H.M. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

Investigation of alcohol fuels for the past several years has provided a sufficient data base to enable systems engineering to identify optimum fuel/engine/vehicle combinations suitable for large scale proof-of-performance field tests of alcohol/gasoline blends. Stimulated by Congressional funding for planning and initiating alcohol/gasoline fleet tests in Government vehicles, the Alternative Fuels Utilization Program (AFUP) is proceeding to conduct these systems and reliability tests in parallel, with the goal of achieving utilization readiness for commercial adoption cica 1982 to 1983. Formulated fuels and appropriate engines have been specified for comparative testing under the systems-oriented Controlled Fleet Test phase. Based on the results of these tests, two fuels will be selected for the Reliability Fleet Test phase. One fuel will be an ethanol/gasoline blend, and the other will be either a methanol/gasoline blend or a methanol/ethanol/gasoline blend. All fuels involve 10-volume percent alcohol. Fuels and vehicles will be representative of anticipated commercial products. Field tests will involve a variety of climatic conditions over a minimum of two annual cycles.

33843 (CONF-790520—, pp II.24.1-II.24.16) **Evaluation of methanol for reduced exhaust emissions in a single-cylinder research engine.** Samaga, B.S.; Gopala Krishnan, K.V.; Murthy, B.S.; Pefley, R.K.; Bechtold, R.L.; Edwards, G.W. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

There is good agreement of these results with recent contemporary work on single cylinder engines fueled with methanol. The addition of aniline to methanol causes an increase in flame speed and a reduction in aldehyde emissions. Water addition to methanol causes reduced flame speed, lower peak flame temperature, and as a consequence, lower NO/sub x/ emissions. Intake mixture preheating causes significant reduction in unburned fuel and aldehyde emissions and an increase in NO/sub x/ emissions at MBT timing which was retarded when compared to operation without preheat. Further research is needed relative to unregulated emissions consequences from the addition of aniline. Time resolved sampling of wall quenched exhaust gas or hot motored techniques and analysis of the early products of oxidation seem to offer deeper insights into the cause of aldehyde formation and its control with suitable additives and needs to be pursued.

33844 (CONF-790520—, pp III.48.1-III.48.13) **Driving cycle comparisons of energy economies and emissions from an alcohol and gasoline fueled vehicle.** Bechtold, R. (DOE, Washington, DC); Pullman, B. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

A late-model vehicle was converted to operate using methanol, gasoline, or ethanol as fuel and experimental work was done to obtain energy economy and exhaust emissions data for each of the three fuels. Results are compared at equal equivalence ratios both with and without an oxidation catalyst in the exhaust system. Using a catalyst for emissions control, unburned (hydro) carbon emissions were lowest during lean operating conditions and were nearly the same for all three fuels under those conditions. Oxides of nitrogen emissions typically were reduced by over 50% in changing from gasoline to methanol or ethanol. Detailed composition of the exhaust hydrocarbons was determined from analysis via gas chromatography. These data were used for calculating photochemical reactivities and comparisons were made among the fuels during cold start and FTP weighted tests. Gasoline exhaust was often calculated to have the lowest total reactivity during the FTP, however, methanol exhaust reactivity was lowest for the stoichiometric condition with catalyst. Aldehydes accounted for large fractions of the reactivity calculated for methanol and ethanol exhausts. Cold start emissions were of about equal reactivity for gasoline and methanol.

33845 (CONF-790520—, pp III.51.1-III.51.11) **Engine experiments with alcohol/diesel fuel blends.** Moses, C.A. (Southwest Research Inst., San Antonio, TX). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

A single-cylinder CLR engine with an open-chamber diesel head has been run on alcohol/diesel fuel blends. Preliminary results are compared on 20% blends of methanol/DH2 as an emulsion and ethanol/DF2 as both a solution and an emulsion. Instabilities in the emulsions made operation erratic and limit the conclusions. Results on higher concentrations of the ethanol/DF2 solution show good combustion on as high as 30% ethanol at all load/speed conditions; 50% concentrations could be used at low speeds. Resultant savings in diesel fuel justify further studies, especially into micro-emulsions of alcohol and diesel fuel.

33846 (CONF-790520—, pp III.52.1-III.52.12) **Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand.** Rentz, R.L.; Timbario, T.J. (Mueller Associates, Inc., Baltimore, MD). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

The paper discusses the current state of technology regarding the use of alcohols for fueling stationary gas turbines. A full scale methanol fueled stationary gas turbine test is in progress. To date, an operational 12.5 hour methanol-fueled utility stationary gas turbine test and a 100 hour bench endurance test of the fuel supply system (the combustion system also was tested) from an industrial scale gas turbine engine have been completed. Further, two combustor tests, one each for methanol and ethanol, utilizing combustors from existing stationary gas turbine engines have been completed. Additionaly, work has been conducted involving alcohols to fuel smaller scale gas turbine engines and combustors (including automotive applications) which should be applicable to the larger scale stationary type gas turbine engines with respect to providing a baseline for further work. Also discussed are projections of peaking gas turbine energy requirements to the year 2000. These projections are then assessed against the potential supply of alcohol fuels as provided by a reasonable commercialization scenario. The overall objectives of this paper then are to present an assessment of: (1) The sufficiency of work performed to establish the feasibility of alcohol as a fuel for stationary gas turbines. (2) Whether or not the status of alcohol fuels utilization technology is defined sufficiently to detail the conversion of existng gas turbines. (3) Whether or not the status of alcohol fuels utilization is defined sufficiently to detail requirements for the design of new product offerings. (4) How well a reasonable commercialization scenario for alcohol fuels production would match projections of future electric utility peaking gas turbine energy demand.

33847 (CONF-790520—, pp III.54.1-III.54.15) **Hardware/software strategies for fuel economy optimization with exhaust emission constraints in methanol fueled automobiles.** McCormack, M.C.; Overbey, J.K.;Pefley, R.K. (Univ. of Santa Clara, CA). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

An experimental investigation of 4-cylinder 2.3L spark ignition engines was undertaken to examine steady-state power, thermal efficiency (fuel economy), and exhaust emissions while operating on methanol at three compression ratios. The effects of camshaft modification, exhaust system modifications, and fuel type are evaluated in terms of both steady state and simulated driving cycles relative to a baseline established at 8.5:1CR on Indolene. Some possibilities of clean engine operation on methanol are discussed in light of possible engine control strategies. Three engine control strategies are introduced for evaluation of current and future engine hardware-carburetion configurations. One of these strategies is based on a constrained mathematical optimization of fuel economy with exhaust emission constraints in an urban driving cycle.

33848 (CONF-790520—, pp III.55.1-III.55.10) **Characterization of alcohol/gasoline blends as a stratified-charge engine fuel: performance and emissions.** AdT. R.R. Jr.; Chester, K.A.; Kajitani, S.; Rhee, K.t.; Spurny, W.F. (Univ. of Miami, Coral Gables, FL). Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

During the present study, experiments (Type II tests) were performed to determine the effect of alcohol addition to unleaded gasoline (Indolene) on the performance and emissions characteristics of a three-valve, carbureted, stratified-charge engine if it were in a stock condition and used to power an automobile. Engine torque and speeds selected simulated 30, 40 and 50 mph cruise (48, 64 and 81 km/hr). The results of these experiments showed the following: (1) when the alcohol blends were substituted for gasoline with no engine adjustments, the torque and engine speed decreased. (2) In order to regain the Indolene-fueled operation values of torque and engine speed, it was necessary to lower the manifold vacuum by opening the throttle. (3) The fuel-air equivalence ratio with the blends was found to be lower than that found during Indolene-fueled operation. (4) The brake thermal efficieny during blend-fueled operation was found to be, in general, lower than that during Indolene-fueled operation. (5) CO emissions were found to either decrease (30 mph simulation) or increase (40 and 50 mph simulation) depending on the cruising speed being simulated. (6) Nitric oxide (NO/sub x/) emissions were, in general, found to decrease with increasing methanol blend level. (7) FID hydrocarbon emissions were found, in general, to increase with alcohol addition. The results obtained during the Type II tests differ in many respects from those obtained with a uniform-charge engine. From a practical point of view, both E10 and M10 blends have a small effect on performance and emissions characteristics.

33849 (CONF-800419—5) **Alternative transportation fuels.** Askew, W.S.; McNamara, T.M.; Maxfield, D.P. (ORI, Inc., Silver Spring, MD (USA)). 1980. Contract AC02-78CS54894. 16p. NTIS, PC A02/MF A01.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The commercialization of alternative fuels is analyzed. Following a synopsis of US energy use, the concept of commercialization, the impacts of supply shortages and demand inelasticity upon commercialization, and the status of alternative fuels commercialization to date in the US are discussed. The US energy market is viewed as essentially numerous submarkets. The interrelationship among these submarkets precludes the need to commercialize for a specific fuel/use. However, the level of consumption, the projected growth in demand, and the inordinate dependence upon foreign fuels dictate that additional fuel supplies in general be brought to the US energy marketplace. Commercialization efforts encompass a range of measures designed to accelerate the arrival of technologies or products in the marketplace. As discussed in this paper, such a union of willing buyers and willing sellers requires that three general conditions be met: product quality comparable to existing products; price competitiveness; and adequate availability of supply. Product comparability presently appears to be the least problematic of these three requirements. Ethanol/gasoline and methanol/gasoline blends, for example, demonstrate the fact that alternative fuel technologies exist. Yet price and availability (i.e., production capacity) remain major obstacles. Given inelasticity (with respect to price) in the US and abroad, supply shortages - actual or contrived - generate upward price pressure and should make once-unattractive alternative fuels more price competitive. It is noted, however, that actual price competitiveness has been slow to occur and that even with price competitiveness, the lengthy time frame needed to achieve significant production capacity limits the near-term impact of alternative fuels.

MATERIALS

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 34063

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 33533, 33871, 33946, 34380

33850 (BDX—613-2397) **Uniform aluminum deposits on large nonplanar and planar polyimide substrates by physical vapor deposition.** Hale, G.J. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 29p. NTIS, PC A03/MF A01.

The capability to deposit 10- to 12-μm-thick aluminum films with less than 2 percent thickness uniformity (defined as standard deviation/average thickness) on large nonplanar and planar polyimide substrates has been developed using physical vapor deposition (PVD). A technique called shadow masking was developed to provide this consistent deposit uniformity over the entire substrate surfaces (greater than 2000 cm^2). The specific dimensions of a shadow mask for each substrate are generated from a computer-reduced plot of beta-backscatter thickness measurements of a previous deposit. With this developed method, initial thickness uniformities of 9.7 and 24.7 percent obtained for the nonplanar and planar deposits were improved to 1.07 and 1.80 percent, respectively.

33851 (CONF-801021—3) **Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing.** Malik, R.K.; Lott, L.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01.

From ASNT fall conference; Houston, TX, USA (6 Oct 1980).

A thermal-mechanical process was applied to Type 304/308 stainless steel GTA welds. The process improved the ultrasonic transmission properties in the weld region. These improvements are attributed to the microstructural changes observed after processing of the austentitic stainless steel welds. Some of the microstructural changes observed were conversion of cast dendrites into equiaxed austenitic grains, and the reduction in size and number of stringers, inclusions, and delta ferrite.

33852 (HEDL-SA—2189) **Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace.** Svedberg, R.C.; Bowen, W.W.; Buckman, R.W. Jr. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 13p. (CONF-800439—12). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

Chemical Vapor Deposit (CVD) rhenium was selected as the muffle material for an 1800°C high thermal efficiency fuel processing furnace. The muffle is exposed to high vacuum on the heater/insulation/instrumentation side and to a flowing argon-8 V/0 hydrogen gas mixture at one atmosphere pressure on the load volume side. During operation, the muffle cycles from room temperature to 1800°C and back to room temperature once every 24 hours. Operational life is dependent on resistance to thermal fatigue during the high temperature exposure. For a prototypical furnace, the muffle is approximately 13 cm I.D. and 40 cm in length. A small (about one-half size) rhenium closed end tube overcoated with tungsten was used to evaluate the concept. The fabrication and testing of the composite tungsten-rhenium tube and prototypic rhenium muffle is described.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 33851, 33861

33853 (LBL—9941) **Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys.** Kubarych, K.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 128p. NTIS, PC A07/MF A01.

Thesis.

The relationship between the microstructure and mechanical properties of spinodally decomposed Fe-Cr-Co ductile permanent magnet alloys was investigated using transmission electron microscopy, electron diffraction, tensile testing, and Charpy impact testing. Isothermal aging and step aging of four alloys (Fe-28 wt % Cr-15 wt % Co, Fe-23 wt % Cr-15-wt % Co-5 wt % V, Fe-23 wt % Cr-15 wt % Co-3 wt % V-2 wt % Ti, and Fe-31 wt % Cr-23 % Co) resulted in decomposition into two phases, an Fe-Co rich (α_1) phase and a Cr rich (α_2) phase. The microstructural features of the decomposition products were consistent with those expected from a spinodal reaction and agree with the reported work on the Fe-Cr-Co system. An Fe-23 wt % Cr-15 wt % Co-5 wt % V alloy was found to have, among the four alloys, the best combinations of strength and ductility.

33854 (LBL—10994) **Sliding wear, toughness and microstructural relationships in high strength Fe/Cr/C experimental steels.** Salesky, W.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 78p. NTIS, PC A05/MF A01.

Thesis.

Hardness has been believed to be the major parameter influencing wear resistance of materials. Recently, it was suggested that combinations of high strength and toughness may lead to optimum wear resistance. It is known that the martensite transformation can be exploited to provide a variety of strength-toughness combinations. Small additions of Mn or Ni to the Fe/4Cr/.3C martensitic alloys have been shown to increase toughness while maintaining strength via increasing the volume fraction of retained austenite. An investigation of the relationships between microstructure, toughness,

and sliding wear resistance for these experimental alloys is reported. Comparative studies were performed on several industrial alloys to provide a practical basis for comparison of these medium carbon experimental steels.

33855 Simulation of the structure of vacancies in high angle grain boundaries. Bristowe, P.D. (Massachusetts Inst. of Tech., Cambridge); Brokman, A.; Spaepen, F.; Balluffi, R.W. Contract 78-12804 DMR; DE-AS02-78ER05002.A001; NSF-DMR-76-01111. *Scr. Metall.;* **14**: No. 8, 943-950(Aug 1980).

A hard sphere dynamic model and a bubble raff model were used in this study of the structure of vacancies in high angle grain boundaries. (FS)

33856 Study of the temperature dependence of the localized vibrations of H and D in niobium. Richter, D.; Shapiro, S.M. (Institut fuer Festkoerperforschung, Kernforschungsanlage Juelich, 517 Juelich, Federal Republic of Germany). *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 599-605(15 Jul 1980).

The second harmonic of the local deuterium vibration in NbD/sub 0.85/ has been observed for the first time. Its energy $h\omega = 170$ meV is 7 meV below the harmonic value of twice the lower local-mode energy, $2h\omega_1$. The measured isotope effect for the lowest local-mode energy is $\omega/\text{sup H}/_1/\omega/\text{sup D}/_1 = 1.365 +- 0.005$ which differs from the harmonic value of (M/sub D//M/sub H/)/ sup 1/2/ = $\sqrt{2}$. The temperature dependence of the local modes for both the deuteride and hydride system exhibit pronounced precursor effects prior to the $\beta \rightarrow \alpha'$ order-disorder phase transition.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 33188, 33615, 33660, 33851, 33853, 33854, 33900

33857 (COO—2975-43) **Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 25 Jun 1980. Contract AC02-76ET34202. 100p. NTIS, PC A05/MF A01.

Results are presented of work performed on the Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program. The objectives of this program are to evaluate candidate alloys for Very High Temperature Reactor (VHTR) Nuclear Process Heat (NPH) and Direct Cycle Helium Turbine (DCHT) applications, in terms of the effect of simulated reactor primary coolant (helium containing small amounts of various other gases), high temperatures, and long time exposures, on the mechanical properties and structural and surface stability of selected candidate alloys. A second objective is to select and recommend materials for future test facilities and more extensive qualification programs. Included are the activities associated with the status of the simulated reactor helium supply system, testing equipment and gas chemistry analysis instrumentation and equipment. The progress in the screening test program is described, including screening creep results and metallographic analysis for materials thermally exposed or tested at 750, 850, and 950°C.

33858 (DOE/ER/10389—1) **Influences of gaseous environment on low growth-rate fatigue crack propagation in steels. Annual report No. 1, January 1980. Report No. FPL/R/80/1030.** Ritchie, R.O.; Suresh, S.; Toplosky, J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 1980. Contract AC02-79ER10389. 43p. NTIS, PC A03/MF A01.

The influence of gaseous environment is examined on fatigue crack propagation behavior in steels. Specifically, a fully martensitic 300-M ultrahigh strength steel and a fully bainitic 2-1/4Cr-1Mo lower strength steel are investigated in environments of ambient temperature moist air and low pressure dehumidified hydrogen and argon gases over a wide range of growth rates from 10^{-8} to 10^{-2} mm/cycle, with particular emphasis given to behavior near the crack propagation threshold ΔK_0. It is found that two distinct growth rate regimes exist where hydrogen can markedly accelerate crack propagation rates compared to air, (1) at near-threshold levels below (5×10^{-6} mm/cycle) and (2) at higher growth rates, typically around 10^{-5} mm/cycle above a critical maximum stress intensity K/ sub max//sup T/. Hydrogen-assisted crack propagation at higher growth rates is attributed to a hydrogen embrittlement mechanism, with K/sub max//sup T/ nominally equal to K/sub Iscc/ (the sustained load stress corrosion threshold) in high strength steels, and far below K/sub Iscc/ in the strain-rate sensitive lower strength steels. Hydrogen-assisted crack propagation at near-threshold levels is attributed to a new mechanism involving fretting-oxide-induced crack closure generated in moist (or oxygenated) environments. The absence of hydrogen embrittlement mechanisms at near-threshold levels is supported by tests showing that ΔK_0 values in dry gaseous argon are similar to ΔK_0 values in hydrogen. The potential ramifications of these results are examined in detail.

33859 (DOE/ET/13513—T1) **Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jul 1980. Contract AC01-78ET13513. 27p. NTIS, PC A03/ MF A01.

This report gives the results of tests designed to measure the threshold stress intensity (K/sub Iscc/) in H_2S of the peak hardness zone in the HAZ of welds in 2 1/4 Cr-1 Mo plate. Difficulty was encountered because of a variability in the location of the peak hardness zone relative to the weld-base interface. There are indications that K/sub Iscc/ could be significantly below 80 ksi$\sqrt{\text{in}}$ but the absolute value could not be determined from the current tests. Details of the forging process and the status of the program are also presented.

33860 (DOE/ET/13513—T2) **Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 6, November 15, 1979-February 15, 1980.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 28 Jul 1980. Contract AC01-78ET13513. 19p. NTIS, PC A02/MF A01.

A modified test technique has been developed in this program to overcome difficulties in assessing the hydrogen embrittlement susceptibility of low strength 2 1/4 Cr-1 Mo steels. One steel sample was tempered to a range of strength levels and evaluated using the new technique. The results, showing a lower strength level for which hydrogen embrittlement susceptibility can be assessed in a 446 KPa H_2S environment, are presented in this report. A review of the restructuring of the program is also given.

33861 (DP-MS—79-73) **J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility.** Dietrich, M.R.; Caskey, G.R. Jr.; Donovan, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 16p. (CONF-800850—1). NTIS, PC A02/MF A01.

From International conference on effects of hydrogen on materials; Jackson Lake Lodge, WY, USA (26 Aug 1980).

The J-integral was evaluated as a parameter to characterize fracture of stainless steels and as a measure of hydrogen damage. C-shaped specimens of type 304L, 316, and 21-6-9 stainless steels were tested in high pressure helium and hydrogen. The critical force for crack initiation (Jm), and tearing resistance (dJ/da) were decreased by hydrogen in all three alloys. The J-integral appears useful as a measure of hydrogen compatibility because it is sensitive to both test environment and microstructure.

33862 (GEFR-SP—205) **Some aspects of materials development for sodium heated steam generators.** Roy, P.; Spalaris, C.N. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Oct 1980. Contract AT03-76SF70030. 32p. (CONF-801036—4). NTIS, PC A03/MF A01.

From Special topical meeting - materials performance in nuclear steam generators; St Petersburg Beach, FL, USA (6 Oct 1980).

A development program was undertaken to support the materials selection for steam generator piping and IHX which are to be used in Liquid Metal Fast Breeder Reactors (LMFBR). Four major topics were reviewed, describing the results obtained as well as the direction of future tests. These topics are: carbon transport in sodium, effect of carbon loss/gain upon materials in the reactor Intermediate Heat Transport System (IHTS), corrosion fatigue and aqueous corrosion. The results support the initial assumptions made in specifying the use of 2-1/4Cr-1Mo as the construction material for the evaporator and superheater and Type 316 piping of the IHT system. Future direction of the experimental programs is to further verify the materials choice and to also obtain information which will be essential during the plant installation, operation and reliability of the components.

33863 (PNL-SA—8295) **Measuring transient high temperature thermal phenomena in hostile environment.** Brenden, B.B.; Hartman, J.S.; Reich, F.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 9p. (CONF-800207—4). NTIS, PC A02/MF A01.

From SPIE meeting; North Hollywood, CA, USA (4 Feb 1980).

The design of equipment for measuring temperature and strain in a rapidly heated and pressurized cylinder of stainless steel is discussed. Simultaneous cinematography of the full circumference of the cylinder without interference with temperature and strain measurements is also illustrated. The integrated system uses a reflective chamber for the sample and requires careful consideration of the spectral energy distribution utilized by each instrument.

33864 Comments on the thermal efficiency of an ideal shape-recovery cycle. Golestaneh, A.A. (Argonne National Lab., IL). *Scr. Metall.;* **14**: No. 8, 845-848(Aug 1980).

The thermal efficiency of the shape recovery phenomena associated with the martensite-parent phase transformation was studied. Mathematical analysis of the phenomena are given. (FS)

33865 Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity. Arieli, A.; Mukherjee, A.K. (Univ. of California, Davis). *Scr. Metall.;* **14**: No. 8, 891-894(Aug 1980).

It is shown that the strain rate sensitivity parameter determined by strain rate change cannot be used to assess the deformation mechanism in superplasticity. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 33323, 33850, 33857, 33863, 34099, 34250

33866 (IS-T—899) **Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems.** Peterman, D.J. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 123p. NTIS, PC A06/MF A01.

Thesis.

Electronic band structure calculations are used to interpret the optical spectra of the cubic Sc, Y and La hydride systems. Self-consistent band calculations of ScH_2 and YH_2 were carried out. The respective joint densities of states are computed and compared to the dielectric functions determined from the optical measurements. Additional calculations were performed in which the Fermi level or band gap energies are rigidly shifted by a small energy increment. These calculations are then used to simulate the derivative structure in thermomodulation spectra and relate the origin of experimental interband features to the calculated energy bands. While good systematic agreement is obtained for several spectral features, the origin of low-energy interband transitions in YH_2 cannot be explained by these calculated bands. A lattice-size-dependent premature occupation of octahedral sites by hydrogen atoms in the fcc metal lattice is suggested to account for this discrepancy. Various non-self-consistent calculations are used to examine the effect of such a premature occupation. Measurements of the optical absorptivity of LaH/sub x/ with $1.6 < x < 2.9$ are presented which, as expected, indicate a more premature occupation of the octahedral sites in the larger LaH_2 lattice. These experimental results also suggest that, in contrast to recent calculations, LaH_3 is a small-band-gap semiconductor.

33867 (IS-T—925) **Surface self-diffusion of vanadium.** Yu, J.M. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 110p. NTIS, PC A06/MF A01.

Thesis.

The decay of periodic profile on the surfaces of single crystalline vanadium specimen is orientation dependent. Faceting occurs on both (100) and (110) surfaces. Periodic profile becomes sinusoidal on the (111) surface and the sinusoidal profile becomes distorted on a surface 9° away from the (111) plane. The surface self-diffusion coefficient of vanadium was determined by using Mullins' theory of sinusoidal profile decay on the (111) surface. The results are D/sub s/ = 66 exp (-48.4 Kcal/mole/RT) cm^2/sec in the [211] direction and D/sub s/ = 288 exp (-50.9 Kcal/mole/RT) cm^2/sec in the [110] direction. The anisotropy indicates that the effect of ledges cannot be neglected. The experimental activation energy is lower than that calculated from the pairwise interaction model and the heat of sublimation. This difference is attributed to the fact that the model does not account for both the lattice relaxation and the electron redistribution at the surface. In general, the surface self-diffusion coefficients of bcc refractory metals can be expressed as D/sub s/ = 3.75 exp (-9.78 Tm/T) cm^2/sec. This expression predicts the diffusion coefficients to within a factor of two or three.

33868 (LBL—10952) **Al_2O_3 adherence on CoCrAl alloys.** Kingsley, L.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 110p. NTIS, PC A06/MF A01.

Thesis.

Adherence of protective oxides on NiCrAl and CoCrAl superalloys has been promoted by a dispersion of a highly oxygen reactive element or its oxide being produced within the protection system. Two aspects of this subject are investigated here: the use of Al_2O_3 as both the dispersion and protective oxide; and the production of an HfO_2 dispersion while simultaneously aluminizing the alloy. It was found that an Al_2O_3 dispersion will act to promote the adherence of an external scale of Al_2O_3 to a degree comparable to previously tested dispersions and an HfO_2 dispersion comparable to that produced by a Rhines pack treatment is produced during aluminization.

33869 (LBL—10995) **Annealing behavior of high permeability amorphous alloys.** Rabenberg, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01.

Thesis.

Effects of low temperature annealing on the magnetic properties of the amorphous alloy $Co_{71.4}Fe_{4.6}Si_{9.6}B_{14.4}$ were investigated. Annealing this alloy below 400°C results in magnetic hardening; annealing above 400°C but below the crystallization temperature results in magnetic softening. Above the crystallization temperature the alloy hardens drastically and irreversibly. Conventional and high resolution transmission electron microscopy were used to show that the magnetic property changes at low temperatures occur while the alloy is truly amorphous. By imaging the magnetic microstructures, Lorentz electron microscopy has been able to detect the presence of microscopic inhomogeneities in this alloy. The low temperature annealing behavior of this alloy has been explained in terms of atomic pair ordering in the presence of the internal molecular field. Lorentz electron microscopy has been used to confirm this explanation.

33870 (SAND—80-1038C) **Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces.** Madey, T.E.; Houston, J.E. (National Bureau of Standards, Washington, DC (USA). Surface Science Div.). 1980. Contract AC04-76DP00789. 20p. (CONF-800908—1). NTIS, PC A02/MF A01.

From 6. international conference on crystal growth; Moscow, USSR (Sep 1980).

The structures of molecular CO adsorbed on atomically smooth surfaces and on surfaces containing monatomic steps have been studied using the electron stimulated desorption ion angular distribution (ESDIAD) method. For CO adsorbed on the close packed Ru(001) and W(110) surfaces, the dominant bonding mode is via the carbon atom, with the CO molecular axis perpendicular to the plane of the surface. For CO on atomicaly rough Pd(210), and for CO adsorbed at step sites on four different surfaces vicinal to W(110), the axis of the molecule is tilted or inclined away from the normal to the surface. The ESDIAD method, in which ion desorption angles are related to surface bond angles, provides a direct determination of the structures of adsorbed molecules and molecular complexes on surfaces.

33871 (UCRL—84440) **Plating on difficult-to-plate metals: what's new.** Wiesner, H.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 30 Jul 1980. Contract W-7405-ENG-48. 22p. (CONF-801031—1). NTIS, PC A02/MF A01.

From Plating on difficult to plate metals symposium; New Orleans, LA, USA (30 Oct 1980).

Some of the changes since 1970 in procedures for plating on such materials as titanium, molybdenum, silicon, aluminum, and gallium arsenide are summarized. While basic procedures for plating some of these materials were developed as many as 30 to 40 years ago, changes in the end uses of the plated products have necessitated new plating processes. In some cases, vacuum techniques - such as ion bombardment, ion implantation, and vacuum metallization - have been introduced to improve the adhesion of electrodeposits. In other cases, these techniques have been used to deposit materials upon which electrodeposits are required.

33872 Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn. Wolf, E.L.; Zasadzinski, J.; Arnold, G.B.; Moore, D.F.; Rowell, J.M.; Beasley, M.R. (Ames Laboratory-U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B: Condens. Matter;* **22**: No. 3, 1214-1217(1 Aug 1980).

A substantially improved description of published electron-tunneling spectra from Nb_3Sn is obtained by taking account of a probable surface proximity layer in the junctions studied. The results satisfactorily describe the superconducting properties of Nb_3Sn within the conventional framework of strong electron-phonon coupling theory, with $\lambda = 1.8 +- 0.15$, $\mu^* = 0.16 +- 0.03$.

33873 Observation of an unusual magnetic phase transition in $NdSn_3$. Hastings, J.M.; Corliss, L.M.; Kunnmann, W.; Thomas, R.; Begum, R.J.; Bak, P. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B: Condens. Matter;* **22**: No. 3, 1327-1330(1 Aug 1980).

We report a neutron-diffraction study of the antiferromagnetic phase transition in $NdSn_3$. The staggered magnetization is a continuous, S-shaped function of temperature with long-range order persisting well above an "apparent" transition temperature. The transition exhibits no measurable hysteresis or critical scattering. This behavior is probably related to the fact that the corresponding $n=6$ Ginzburg-Landau-Wilson Hamiltonian possesses no stable fixed point.

33874 Activation of FeTi for hydrogen absorption: an electron microscopic study. Pande, C.S.; Pick, M.A.; Sabatini, R.L. (Brookhaven National Lab., Upton, NY). *Scr. Metall.;* **14**: No. 8, 899-903(Aug 1980).

An analytical electron microscope study of the electrolytic hydrogenation of FeTi is reported. Direct evidence of the physical separation of the oxidized surface layer is shown. This shows that

the H reaches the FeTi alloy without diffusing through the oxide layer. (FS)

33875 Confirmation of McMillan's concept of "discommensurations". Suits, B.H.; Couturie, S.; Slichter, C.P. (Physics Department and Materials Research Center, University of Illinois, Urbana, Illinois 61801). DE-AC02-76ER01198. *Phys. Rev. Lett.;* **45**: No. 3, 194-197(21 Jul 1980).

^{77}Se NMR is used to study a proposal made by McMillan regarding the charge-density wave (CDW) in 2H-$TaSe_2$. The dependence of the NMR line shape is compared with predictions based on McMillan's theory. McMillan's hypothesis of "discommensurations" is confirmed: that the so-called incommensurate CDW is best described by commensurate regions separated by regions of phase slip.

33876 High-resolution angle-resolved-photoemission studies of the MB-point surface state on Cu (001). Kevan, S.D.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 542-548(15 Jul 1980).

High-resolution angle-resolved-photoemission studies were carried out on the surface state reported by Heimann et al. at the MB point of the two-dimensional surface Brillouin zone of Cu (001). The symmetry of the state is shown to be odd with respect to the (100) mirror plane, as hypothesized by Heimann et al. Experimental E(k/sub parallel/) dispersion relations in good agreement with the earlier study are reported, and accurate determinations of peak width as a function of k/sub parallel/ are shown to be reasonably well fitted by a simple model. A novel temperature effect is reported and interpreted in terms of substantially enhanced vibrational amplitude of the surface layer.

33877 Angle-resolved photoemission determination of Λ-line valence bands in Pt and Au using synchrotron radiation. Mills, K.A.; Davis, R.F.; Kevan, S.D.; Thornton, G.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 581-592(15 Jul 1980).

Angle-resolved photoemission spectra are reported for Au (111) and Pt (111) in the photon-energy range $6 < \text{or} = h\nu < \text{or} = 33$ eV. Experimental dispersion relations along Λ were derived for both crystals; comparison with relativistic augmented-plane-wave calculations showed generally good qualitative agreement, but quantitative disagreement of the order of a few tenths of an eV. Band energies are tabulated; values at Γ are $\Gamma_8 = 3.55, 5.90$, $\Gamma_7 = 4.45$ eV for Au; $\Gamma_8 = 1.40, 4.07$, $\Gamma_7 = 2.80$ eV for Pt. The s band is found to be ca. 1 eV (Pt) and 0.5 eV (Au) less bound than the theoretical prediction. Ligand field parameters at Γ are presented for both samples: $\xi(5d) = 0.71 +- 0.05$ eV, $10Dq = 1.22 +- 0.05$ eV for Au; $\xi(5d) = 0.66 +- 0.05$ eV, $10Dq = 1.78 +- 0.05$ eV for Pt. The systematics of 10Dq in the noble metals is discussed. The polarization dependence of the spectra was used to assign initial-state symmetries empirically: bands 3, 5 show Λ_6 symmetry, bands 2, 4, 6, $\Lambda_4 + \Lambda_5$. Cooling of the Au crystal showed that the "s-p plateau" is due to a thermally insensitive indirect process, and that both thermal diffuse scattering and phonon-assisted inelastic processes contribute to the loss of spectral contrast at room temperature. Resonances in intensity with photon energy were investigated and assigned in terms of the final-state band structure.

33878 Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au. Olson, C.G.; Lynch, D.W.; Rosei, R. (Ames Laboratory, U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 593-598(15 Jul 1980).

Thermotransmission and thermoreflectance spectra were obtained for Cu, Pd, Ag, Pt, and Au in the 10 —30 eV spectral region. Structures due to transitions from the Fermi level to high-density bands 15 eV above the Fermi level were identified in Pt. All metals showed structures arising from interband transitions between the d bands and the same flat bands, 15—20 eV above the Fermi energy. Attempts to fit to interband critical points in Au revealed over 40 possible critical points in the region of these structures, most of them near the Brillouin-zone centers. Systematic trends in the series of metals make the qualitative identification of the structures more secure, and no energy shifts of calculated energy bands are required. The observed widths of structures are sometimes much narrower than the widths of free-electron-like bands at comparable energies.

33879 Further studies of Ni (001)c(2 x 2)CO: Evidence for back donation in the chemisorption bond. Smith, R.J.; Anderson, J.; Lapeyre, G.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 632-637(15 Jul 1980).

We report new results for the chemisorption system Ni (001)c(2 x 2)CO using angle-resolved polarization-dependent photoemission with synchrotron radiation ($10 < \text{or} = h\nu < \text{or} = 40$ eV). Adsorbate-induced structure with π-like symmetry is observed in normal emission at E/sub i/ ≅ -2.2 eV, and in the (100) mirror plane off normal at E/sub i/ ≅ -1.3 eV. Using the back-bonding scheme of Blyholder, an interpretation is given in terms of the mixing of metal dπ orbitals with the empty 2π orbital of molecular CO.

33880 Donor complex with tunneling hydrogen in pure germanium. Joos, B.; Haller, E.E.; Falicov, L.M. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 832-840(15 Jul 1980).

A shallow donor complex observed by several authors in ultrapure germanium grown in a hydrogen atmosphere is attributed to an oxygen-hydrogen system. Photoconductivity data under stress are presented. An abrupt transition in the spectra at a well-defined stress (2.1×10^8 dyn cm^{-2}) is found. It is explained by a theory which involves dynamic tunneling of the hydrogen in the vicinity of an oxygen center. The comparison with other complex donors and acceptors supports the model.

33881 Observation of a strongly enhanced magnetic susceptibility of Pd in Au-Pd-Au sandwiches. Brodsky, M.B.; Freeman, A.J. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **45**: No. 2, 133-137(14 Jul 1980).

Exceptionally large increases in the magnetic susceptibility (indicating nearly magnetic ordering) of thin films of Pd sandwiched between thicker Au films have been observed at low temperatures - presumably due to the expansion of the Pd average lattice constant by the Au. The large resultant Stoner factors and the modified paramagnon model of Levin and Valls indicate the possibility of observing p-wave superconductivity in Pd structures with reduced proximity effects.

33882 Resistivity due to hydrogen in transition metal alloys. Westlake, D.G.; Miller, J.F. (Argonne National Lab., IL (USA)). *J. Phys., F (London);* **10**: No. 5, 859-863(May 1980).

Experimental values are reported for the temperature dependences of the incremental resistivity due to hydrogen in pure Ta and in Nb-Ta, Nb-V, Nb-Ti and Nb-Mo alloys. The results seem best explained by consideration of (i) the interactions between interstitial H atoms and the substitutional solutes and (ii) the possible importance of electronic effects. The influence of the vibrational amplitude of hydrogen interstitials on the temperature dependence of the hydrogen resistivity increment may be too slight to detect in the presence of the aforementioned effects.

33883 (RFP-Trans—285) Density measurements at high temperatures. Part XII. Specific volume and expansion of magnesium-zinc alloys in the solid and liquid states. Pelzel, E.; Sauerwald, F. Translated from *Z. Metallkd.;* **33**: No. 6, 229-232(1941). 7p. NTIS, PC A02/MF A01.

The specific volume of magnesium-zinc alloys as a function of concentration was determined at various temperatures in the solid and liquid state up to 800°C. The alloys form in this entire range, with considerable contraction which, in particular, suggests the existence of intermetallic compounds in the liquid state. This observation is of special importance for the magnesium-zinc alloys because it is comparable with determinations of the same problem by other methods, and thus is confirmed. The measurements also yielded shrinkage values in the entire range and at the solidification point.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 33173, 33514, 33516, 33615, 33857, 33862, 33868, 33871, 34064

33884 (BDX—613-2396) Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report. Clay, F.A. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 31p. NTIS, PC A03/MF A01.

Sulfuric-acid-anodized and electroless-nickel-plated 7075 aluminum alloy panels successfully passed 96 hours of salt spray testing when galvanically coupled to duplex-annealed Ti-6Al-6V-2Sn alloy panels. Adherent paint deposits were produced on the titanium alloy and electroless nickel surfaces using a wash primer, an epoxy primer, and a urethane paint coating. A painted part survived 35 cycles of alternating salt spray and hot and freezing environments without blistering. A low chloride cutting fluid was selected for production machining of Ti-6Al-6V-2Sn, based on chemical analysis and stress-corrosion tests. A cleaning process was developed to remove both titanium and aluminum cutting fluids. Modified wedge-opening-loading specimens were used to verify that no stress-corrosion cracking problems occurred with the duplex-annealed Ti-6Al-6V-2Sn alloy because of residual titanium or aluminum cutting fluids.

33885 (DOE/ER/05246—4) Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980. Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). May 1980. Contract AS05-76ER05246. 169p. NTIS, PC A08/MF A01.

Investigations are being conducted on mechanisms involved with the hydrogen-metal interactions which control the absorption and desorption processes in intermetallic compounds. The status of the following investigations is reported: modeling of hydride formation; microbalance investigations; microstructure investigations; flexure experiments; resistivity experiments; and nuclear backscattering measurements. These investigations concern fundamental hydrogen interaction mechanisms involved in storage alloys.

33886 (GA-A—15825) **Investigation of several commercial aluminide coatings for carburization protection of a nickel-base alloy.** Lai, G.Y. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET35300. 24p. NTIS, PC A02/MF A01.

Four commercial aluminide coatings applied to Hastelloy Alloy X were investigated with respect to their carburization resistance in a carburizing impure helium environment. The test gas was helium with 500 μatm H_2, 50 μatm CO, 50 μatm CH_4, and < 1.0 μatm H_2O. The uncoated specimens exposed to this test environment at 900°C (1650°F) for 1000 and 2000 h exhibited significant carburization. All four coatings provided good protection against carburization of the substrate Hastelloy Alloy X, presumably due to the formation of an Al_2O_3 oxide scale on the coating surface during the high-temperature corrosion exposure. The Al_2O_3 oxide is believed to be an effective barrier to carbon transport. Aluminide coatings applied to Hastelloy Alloy X exhibited a tendency for forming Kirkendall diffusion voids (or pores) in the diffusion zone during long-term high-temperature exposures [e.g., 900°C (1650°F) for 1000 h]. Chromium addition during aluminizing, which resulted in a high chromium content in the coating, appears to be effective in preventing the pore formation during subsequent long-term high-temperature exposures.

33887 (IS—4747) **Bibliography of hydrogen attack of steel and relevant ancillary topics.** Verkade, M.E.; Scott, T.E. (Ames Lab., IA (USA)). Jul 1980. Contract W-7405-ENG-82. 261p. NTIS, PC A12/MF A01.

Hydrogen attack of steels is a well known phenomenon in the petroleum refining and petrochemical industries. However, despite many years of experience with the phenomenon, hydrogen attack is not understood from a first principles point of view. A resurgence of interest in this design-limiting phenomenon has occurred recently as a result of developments in coal liquefaction and gasification processes. Several plant components for these developing processes, especially pressure vessels, involve hydrogen containment at high temperatures and pressures. A failure prediction capability and a sound scientific basis for the development of hydrogen-attack resistant, low-cost alloys for critical components would be invaluable to designers of these coal conversion process plants. Research efforts directed toward achieving the understanding needed to attain such capabilities will be more effective if full advantage is taken of the relevant information that exists in the literature. Consequently, an extensive literature search was undertaken to assist investigators of hydrogen attack. The search covered not only the specific topic of hydrogen attack, but also several ancillary topics which have immediate or potential relevance to the subject. The scope of the literature search included chemical abstracts from 1957 to 1977, metals abstracts from 1966 to 1977, as well as many journals which were searched to 1980. A list of journals cited in the bibliography may be found in Appendix I. Some relevant older articles are also included. Whether every relevant reference has been cited is not certain, but it is believed that the search was thorough and complete.

33888 (LBL—11202) **High-temperature oxidation and corrosion of materials program.** Whittle, D.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

Research progress is reported in the behavior of metals and alloys in gas mixtures at high temperature, corrosion mechanisms in complex environments of low oxidizing potential, hot corrosion of nickel-base alloys at intermediate temperatures, corrosion of solid sulfate deposits, adherence of Al_2O_3 oxide films, oxidation behavior of a two-phase alloy Fe-44% Cu, and formation of subscales of varying composition. (FS)

RADIATION EFFECTS

33889 **Gamma prime hardened nickel-iron based superalloy.** (to Department of Energy, Washington, DC (USA)). British Patent 1,559,069/A/. 16 Jan 1980. 9p.

A specification is presented for a gamma pri.ne strengthened and solid solution hardened nickel-iron base alloy, which contains, in addition to nickel, iron and chromium, smaller proportions of Mo, Ti, Al, Si, C, Mn, and possibly B, V and Zr. The alloy is said to be useful for liquid metal breeder reactor duct and cladding applications; and to have improved void swelling properties.

33890 **Microstructure of single and dual-ion irradiated Fe-20Ni-15Cr and Ti-6Al-4V alloys.** Agarwal, S.C. (IIT Research Inst., Chicago, IL (USA)); Ayrault, G.; Potter, D.I.; Taylor, A.; Nolfi, F.V., (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **85**: No. 86, 653-657(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

An experimental austenitic alloy, Fe-20 wt.% Ni-15 wt.% Cr, and a commercial titanium alloy, Ti-64 (Ti-6 wt.% Al-4 wt.% V), have been dual-ion irradiated with heavy ions (Ni^+ or V^+) and $^3He^+$, and also single-ion irradiated with heavy ions. For the Fe-Ni-Cr alloy, a dose dependence study at 700°C revealed that swelling decreased as the rate of helium injection was increased from 5:1 to 55:1 He:dpa (appm He:dpa); concomitantly, the nature of the cavities changed from void-like (underpressured) at 5:1 He:dpa to near equilibrium (or possibly overpressured) helium bubbles at 55:1 He:dpa. Furthermore, simultaneous injection of helium at 16:1 He:dpa did not cause a significant change in the peak swelling temperature. In the titanium alloy, both single and dual-ion irradiations caused profuse precipitation of β-phase (BCC) platelets in the α-phase (HCP) matrix at all irradiation temperatures (450-650°C). Cavities formed only at the highest irradiation temperature (660°C) during single-ion irradiation, but formed at all irradiation temperatures (541-624°C) for dual-ion irradiation at 10:1 He:dpa.

33891 **Effect of He on the swelling/microstructure produced in Mo by ion bombardment.** Brimhall, J.L.; Charlot, L.A.; Kissinger, H.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *J. Nucl. Mater.;* **85**: No. 86, 731-734(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Pure molybdenum has been bombarded simultaneously with heavy ions and helium in a dual beam accelerator facility to simulate the helium generation and displacement damage expected in a fusion reactor first wall. Compared to the damage produced by the heavy ions (7 MeV Ta^{+++})alone, simultaneous helium injection results in a high void density that continues to increase with dose. The results suggest continuous void nucleation due to the helium. The swelling during dual beam irradiations is essentially independent of dose at high dose levels. At high doses >= 40 dpa, the helium has little effect on the absolute magnitude of the swelling which is approximately 0.5% with or without helium. Comparisons are made to extrapolated swelling data from fission neutron irradiation studies.

33892 **Ductility in bending of molybdenum alloys irradiated between 425 and 1000°C.** Cox, B.L.; Wiffen, F.W. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 901-905(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Molybdenum and the alloys Mo-0.5% Ti and TZM were irradiated at four temperatures between 425 and 1000°C to a displacement level of 11 dpa at a fluence of 2.5 x 10^{26} n/m² (> 0.1 MeV). Vacuum bend tests at elevated temperatures showed the ductile-to-brittle transition temperature (DBTT) to be above room temperature for all irradiation temperatures. Irradiation at 585°C produced the highest DBTT, 550 to 700°C. Differences among the three materials were minor.

33893 **Experimental method to determine the role of helium in neutron-induced microstructural evolution.** Gelles, D.S.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA). Materials Development). *J. Nucl. Mater.;* **85**: No. 86, 689-693(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

A method is presented which allows the determination of the role of helium on microstructural evolution in complex alloys and which avoids many of the problems associated with other simulation experiments. It involves a direct comparison of the materials' response to a primary difference in fission and fusion environments, namely the rate of helium generation. This is accomplished by irradiating specimens in a fission reactor and conducting microstructural analyses which concentrate on alloy matrix regions adjacent to precipitates rich in boron or nitrogen. Such precipitates generate well-defined atmospheres of helium (and other transmuted atoms) due to (n,α) reactions during irradiation. Microstructural comparisons are made between the regions bearing implanted helium and those just beyond the helium range. The method takes advantage of virtually no variation in alloy composition and pre-irradiation microstructure over short distances, and can be used to study any material of interest if the appropriate precipitates can be developed. A variety of helium/dpa ratios can be obtained in one specimen by using precipitates of various sizes. Procedures are outlined for calculation of background and injected helium levels as well as displacement doses generated by neutrons and alpha particles. An example of the analysis method is shown for an experimental austenitic stainless steel containing boride particles and irradiated to 3 and 7 x 10^{22} n/cm² (E > 0.1 MeV).

33894 **Tensile properties of type 316 stainless steel irradiated in a simulated fusion reactor environment.** Grossbeck, M.L.; Maziasz, P.J.

(Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 883-887(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Tensile and fracture properties of type 316 stainless steel in the annealed and 20% cold-worked conditions were investigated to neutron fluences producing 16 dpa and 1000 at. ppm He resulting from irradiation in the High Flux isotope Reactor. Tensile elongations remained above 6% at 350 and 450°C and 4% at 575°C. Fracture behavior has been examined in the 20% cold-worked material. At 350°C the fracture mode is unchanged by irradiation and is characterized by ductile tearing. At 450°C irradiation causes the fracture mode to change from ductile tearing to crystallographic fracture which may occur along the slip bands introduced by the cold working. At 575°C the fracture is changed from ductile transgranular to intergranular. The tensile properties observed are believed to be adequate for fusion reactor service within the values of damage parameters investigated.

33895 Microstructure and tensile properties of T(d,n) and Be (d,n) neutron irradiated nickel, niobium and 316SS. Jones, R.H.; Styris, D.L.; Bradley, E.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)); Greenwood, L.R.; Heinrich, R.R. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **85**: No. 86, 889-893(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The radiation damage induced in nickel, niobium and 316SS by T(d,n) and Be(d,n) neutrons was evaluated by microstructural analysis and mechanical property measurements. Also, the neutron flux gradients in the Be(d,n) neutron source were compared to the positional dependence of the yield strength of niobium wires. The microstructure and yield stress increase of T(d,n) and Be(d,n) neutron irradiated nickel were similar while there were differences in niobium.

33896 Effects of radiation-induced segregation and preferential sputtering on the sputtering rate of alloys. Lam, N.Q.; Wiedersich, H. (Argonne National Lab., IL (USA). Materials Science Div.); Leaf, G.K. (Argonne National Lab., IL (USA). Applied Mathematics Div.). *J. Nucl. Mater.;* **85**: No. 86, 1085-1089(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Changes in the surface composition and in the sputtering rate of binary alloys were calculated using a kinetic model that includes the effects of radiation-induced segregation and preferential sputtering. Numerical solutions were obtained for two dilute Ni-based model alloys, Ni-Cu and Ni-Mo, under 5-keV Ar^+ ion bombardment as functions of sputtering time, temperature, and initial alloy composition. In the temperature range 200-850°C, the sputtering rate is initially affected by strong radiation-induced segregation. As the bombardment time increases, preferential sputtering becomes dominant; the surface composition and hence, the sputtering rate, approach the steady-state values determined entirely by the sputtering coefficients of the alloy components. Below 200 and above 850°C, the sputtering rate is controlled by preferential sputtering only because radiation-induced segregation is insignificant in these temperature regimes.

33897 Effect of nickel and nitrogen on void formation in ion bombarded vanadium. Lott, R.G.; Kulcinski, G.L.; Wilkes, P. (Wisconsin Univ., Madison (USA)); Smith, H.V. Jr. (Los Alamos Scientific Lab., NM (USA)). *J. Nucl. Mater.;* **85**: No. 86, 751-755(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The objective of this study is to determine how both substitutional and interstitial solutes affect void formation in vanadium. Samples of high purity vanadium have been doped with 1% to 8% nickel, or with 1% nitrogen and irradiated with 14 MeV Cu ions to dose levels between 1 and 10 dpa at 6 x 10^{-4} dpa/sec. Swelling is observed at temperatures ranging from 450°C to 650°C in high purity vanadium at 2.5 dpa. The peak swelling temperature at this dose level is 550°C. The addition of > 2% Ni to the high purity vanadium completely suppressed void formation at temperatures between 350°C and 650°C. Samples doped with 1% Ni exhibited extremely low void densities. In samples irradiated at 450°C, 550°C and 650°C nitrogen doping reduced the void density. This effect resulted in a generally decreased level of swelling in the V-1% N samples.

33898 Tensile properties of high oxide SAP containing helium and tritium. Maziasz, P.J.; Farrell, K. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 913-917(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Up to 1700 appm each of ^4He and ^3H were created in SAP alloys (sintered aluminum product) of 17-25 wt% oxide by doping the alloys with ^6Li and irradiating in a thermal reactor at ambient temperature. To simulate the distribution of these gases at a proposed fusion reactor first-wall operating temperature of about 670°K, the irradiated SAP was annealed for 1000 h in the range 573 to 773°K (0.61 to 0.83 Tsub(m)). Immersion density measurements indicated no discernible swelling from the gases, some of which was shown to be trapped in tiny bubbles at the Al_2O_3-Al interfaces. Tensile tests performed in the temperature range 310 to 773°K reveal no significant effects of the gases on strength, ductility or fracture model. However, the ductility in the unirradiated condition was low (less than 0.5% at 673°K). These data suggest that although a fine distribution of stable second-phase particles in first-wall alloys might provide a means of ameliorating gas swelling and embrittlement, there may be a high cost in terms of fabrication problems and original ductility.

33899 Irradiation creep studies of titanium alloys. Nygren, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). *J. Nucl. Mater.;* **85**: No. 86, 861-865(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Stress relaxation measurements were performed on four titanium alloys, Ti-6Al-4V (in three heat treat conditions), Ti-6242S, Ti-5621S, and Ti-15-333. The specimens were thin rectangular beams elastically bent in uniform radii of curvature and irradiated to a fluence of 4 x 10^{21} n/cm² (E > 0.1 MeV) at about 450°C in EBR-II. Postirradiation measurements of the residual curvature of the specimens indicated the amounts of irradiation creep that had occurred. Although further experimental work is required to separate primary and steady state creep components, the data provided a good comparison between the alloys and with stainless steels irradiated in similar tests. Among the titanium alloys irradiated, the superalpha alloys Ti-5621S and Ti-6242S had the greatest creep strengths, about equal to CW 316 SS. The beta alloy Ti-15-333 and Ti-6Al-4V in the duplex annealed condition were weakest. TEM and optical metallography were performed on the post-irradiation microstructure of some alloys. Beta platelets and linear precipitate arrays were observed in the mill anneal and duplex anneal conditions of Ti-6-4. An ordered phase α_2 also was found in the duplex structure.

33900 Light ion irradiation-induced creep mechanisms in nickel. Simonen, E.P.; Hendrick, P.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *J. Nucl. Mater.;* **85**: No. 86, 873-876(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Irradiation creep of fusion reactor structural materials is important for considerations of dimensional stability and creep rupture failure predictions. In the present work, the predicted creep response at 200°C of both cyclic and steady-state deuteron irradiated nickel is analyzed and compared with experiment. The cycle characteristics were chosen to be similar to that expected for a tokamak, i.e., 1000 seconds irradiation followed by 100 seconds at temperature without irradiation. The cyclic creep rate is observed to be approximately three times the creep rate with continuous irradiation. The analysis of both the continuous beam and cyclic beam results support the conclusion that the radiation induced creep mechanism is enhanced climb-glide creep and not stress induced preferential absorption (SIPA).

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 33821, 33952

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 33306, 33307, 33754

33901 (BDX—613-2398) **Photoresist dip coating on thin film networks. Final report.** Hughs, R.W.; Barner, G.E. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 23p. NTIS, PC A02/MF A01.

Application of liquid photoresist by dip coating was investigated as potentially more reliable and repeatable than the current roller coating process. Resist viscosity, extraction rate, and substrate orientation were found to affect applied resist thickness and uniformity. The data accumulated in this effort will be used in future work to develop an improved photoresist application process.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 34372

33902 (DOE/ER/01198—134) **Electron paramagnetic resonance studies of beta-alumina, a prototype glass.** Kurtz, S.R. (Illinois Univ., Champaign (USA). Physics Research Lab.). 1980. Contract AC02-76ER01198. 145p. NTIS, PC A07/MF A01.

Thesis.

Electron paramagnetic resonance techniques are used to study single crystal Na, K, and Li beta-alumina. Color centers are introduced into this material by irradiating the samples with electrons at liquid nitrogen temperature. Using electron paramagnetic resonance and electron nuclear double resonance, the color centers generated in this manner are identified, and their location within the material is determined. For one of these centers, an F^+ center, the electron spin relaxation rate is measured over the range 2 to 20°K using the pulse saturation and recovery technique. These measurements reveal an exceptionally fast relaxation rate with anomalous temperature and microwave frequency dependence. Beta-alumina is a structurally unique system. It is partially disordered and consists of ordered blocks of aluminum oxide separated by planar disordered regions. Extensive measurements have shown that beta-alumina displays properties identical to those observed for glasses at low temperature as a result of this limited structural disorder. These glass-like properties have been explained by proposing that atomic tunneling occurs in beta-alumina at low temperature producing a system of localized two level states. A model is developed which quantitatively describes the electron spin relaxation data. The proposed relaxation mechanism couples the color center spin to the phonon induced relaxation of a nearby localized two level tunneling state. A detailed comparison shows that this model is in good agreement with earlier heat capacity, thermal conductivity, and dielectric susceptibility measurements in beta-alumina.

33903 Magnesium aluminate spinel precipitation in MgO. Berthelet, C.; Kingery, W.D.; Vandersande, J.B. (Massachusetts Inst. of Tech., Cambridge). *Ceramurgia Int.;* **2**: No. 2, 62-66(1976).

Magnesium aluminate spinel precipitates forming in polycrystalline MgO containing 0.43 weight % Al and 0.031 weight % Al were examined by transmission electron microscopy after air quenching or rapid cooling. Precipitation in a variety of morphologies occurred at grain boundaries, low angle grain boundaries and dislocations. On reheating a virgin surface, precipitation occurs at temperatures above 730°C.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 33173

33904 Creep of 90+ % Al_2O_3 refractory concrete. Bray, D.J.; Smyth, J.R.; McGee, T.D. (Iowa State Univ., Ames). Contract ET-78-S-01-2873. *Am. Ceram. Soc. Bull.;* **59**: No. 7, 706-710(Jul 1980).

From 81. annual meeting of the American Ceramic Society; Cincinnati, OH (1 May 1979).

Uniaxial compressive creep of a 90+ % Al_2O_3 refractory concrete composed of a high purity tabular alumina aggregate phase and a high purity calcium-aluminate cement phase was investigated. Steady-state creep was measured under stresses of 6.9 to 17.2 MPa at 538° to 1204°C. Creep of the pure calcium-aluminate cement was also investigated under stresses of 6.9 to 13.8 MPa at 538° to 1149°C. Activation energy for creep of the concrete was found to be ≃ 171 KJ/mol, while for the cement it was ≃ 134 KJ/mol. Both values were determined from steady-state strain rates at 13.8 MPa. The stress exponent was found to be ≃ 1.7 at 1093°C for the concrete and ≃ 2.3 at 982°C for the cement. These activation energies and stress exponents are appropriate only for steady-state creep over the conditions tested. SEM microscopy and porosity and density data were used to gain insight into creep behavior and possible creep mechanisms of this system.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 33755, 33902

33905 Low temperature specific heats of three plutonium carbides. Haines, H.R.; Hall, R.O.A.; Lee, J.A.; Mortimer, M.J. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.); McElroy, D. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **88**: No. 2/3, 261-264(Feb 1980).

The low temperature specific heats of plutonium monocarbide and of two samples of plutonium sesquicarbide are reported. The monocarbide shows a small anomaly superimposed on the normal sigmoid form of the specific heat curve, associated with magnetic ordering at the Neel temperature of 45 K. The sesquicarbides do not show magnetic ordering. The specific heats and derived entropies are given for comparison with other published data and with the high temperature data in the following paper.

33906 Effects of cold rolling on fluxoid pinning in a superconducting metallic glass. Koch, C.C.; Scarbrough, J.O.; Kroeger, D.M.; DasGupta, A. (Oak Ridge National Laboratory, Metals and Ceramics Division, P.O. Box X, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Appl. Phys. Lett.;* **37**: No. 5, 451-453(1 Sep 1980).

Results exhibiting the influence of cold rolling fluxoid pinning in a metalic glass superconductor (Mo/sub 0.6/Ru/sub 0.4/)$_{82}$B$_{18}$ are reported. Inhomogeneous deformation up to 20% reduction in thickness does not change either the superconducting transition temperature T/sub c/ or upper critical field H/sub c/$_2$ but does degrade the critical current density by as much as 34% from the value in the the as-cast condition. Possible mechanisms for this degradation of J/sub c/ are suggested. Pinning by inhomogeneities in composition or density rather than by the simple surface or unresolved second-phase precipitates appears to be likely.

33907 Self-consistent electronic structure of the refractory metal ZrB_2, a pseudographite intercalation compound. Johnson, D.L.; Harmon, B.N.; Liu, S.H. (Physics Department, Northeastern University, Boston, Massachusetts 02115). *J. Chem. Phys.;* **73**: No. 4, 1898-1906(15 Aug 1980).

The self-consistent band structure of ZrB_2 has been evaluated using the KKR method. It is noted that a large charge transfer is not necessary to explain many of the experimental results which can be understood in terms of the band structure and the bonding nature of the wave functions. X-ray photoemission spectra and optical reflectance measurements are compared with the calculated density of states and joint density of states, respectively. The calculations are also discussed with reference to nuclear quadrupole experiments, Hall effect measurements, and the electronic specific heat. The similarities to intercalated graphite and related compounds are discussed and the strong bonding as reflected in the hardness and high melting point is considered.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 33173, 33755

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

33908 (BNL—51194) Development of a glass polymer composite sewer pipe from waste glass. Final report. Rayfiel, R.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Feb 1980. Contract AC02-76CH00016. 76p. NTIS, PC A05/MF A01.

A range of polymer-aggregate composites for applications in industry which appear to be economically attractive and contribute to energy conservation were developed at BNL. Waste glass is the aggregate in one such material, which is called glass-polymer-composite (GPC). This report assays the economics and durability of GPC in piping for storm drains and sewers. The properties of the pipe are compared statistically with the requirements of industrial specifications. These establish the raw materials requirements. The capital and operating costs for producing pipe are then estimated. Using published sales values for competing materials, the return on investment is calculated for two cases. The ultimate energy requirement of the raw materials in GPC is compared with the corresponding requirement for vitrified clay pipe. The strengths of GPC, reinforced concrete, vitrified clay and asbestos cement pipe are compared after extended exposure to various media. The status of process and product development is reviewed and recommendations are made for future work.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 33908

33909 (UCRL—83875) Failure modes and durability of Kevlar/epoxy composites. Morgan, R.J.; Mones, E.T.; Steele, W.J.; Deutscher, S.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jun 1980. Contract W-7405-ENG-48. 13p. (CONF-801010—2). NTIS, PC A02/MF A01.

From 12. National Society for the Advancement of Materials and Process Engineering technical conference; Seattle, WA, USA (7 Oct 1980).

The fracture topographies of Kevlar 49/epoxy composite strands and multilayer composites in the form of pressure vessels are discussed in terms of the microscopic deformation and failure processes of the composites. The effect of resin ductility and fiber-matrix interfacial bond strength on mechanisms of fiber damage are considered. The failure of the Kevlar 49 fibers by a splitting process and the parameters, such as fiber fibrillation and macromolecular chain scission, that control such a process, are discussed in relation to fiber and composite performance.

PHYSICAL PROPERTIES

33910 Photoelectric effects in magnesium aluminum spinel. Woosley, J.D.; Wood, C.; Sonder, E.; Weeks, R.A. (Northern Illinois University, DeKalb, Illinois 60115). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 1065-1072(15 Jul 1980).

The electronic and transport properties of magnesium aluminum spinel have been investigated photoelectrically. Photoemission of holes and electrons into spinel from metal contacts (Pt, Au, Ta, Mo, and Cu) has been used to determine barrier heights. From this information, as well as vacuum-uv photoconductivity data, we have obtained the following energy-band parameters: The Fermi level lies ~ 3 eV below the bottom of the conduction band, which in turn is located ~ 2 eV below the vacuum level, and the band gap is ~ 9 eV. Photoemission was not observed from graphite electrodes which form Ohmic contacts. Electron, neutron, or gamma irradiation produced three photoconductivity bands of half-width ~ 0.5 eV, with peaks at 4.5, 5.0, and 5.5 eV. The three bands, equally spaced in energy, may be associated with the same center. The optical absorption band of the F center is in the same region of the spectrum; however, its shape did not correspond to the observed photoconductivity spectrum. A lower limit of 10^{-6} cm^2/V has been calculated for the μtau product of the photogenerated charge carriers.

POLYMERS AND PLASTICS

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 33521

33911 (UCRL—83783) **Acoustic emission for quality control of kevlar 49 filament-wound composites.** Hamstad, M.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1980. Contract W-7405-ENG-48. 15p. (CONF-801010—1). NTIS, PC A02/MF A01.

From 12. National Society for the Advancement of Materials and Process Engineering technical conference; Seattle, WA, USA (7 Oct 1980).

A study was made to relate production variables to changes in proof-test-generated acoustic emission (AE) from NASA-type filament-wound pressure vessels. Some of the deliberate manufacturing errors were matrix content, cure cycle, matrix component ratios, degraded fiber, moisture content, and winding tension. The 11-cm-diameter spherical pressure vessels were made by filament winding Kevlar 49/epoxy on aluminum mandrels. After proof testing, the vessels were burst tested. Certain production variables resulted in significant changes in AE amplitude and associated stress level.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 33521

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 33397, 33404, 33406, 33408, 33409, 33410, 33411, 33412, 33534, 33574

33912 (DOE/DP/40050—9) **Development of ferromagnetic spinels for optical isolation at 10.6 μm.** Teegarden, K.J. (Rochester Univ., NY (USA). Inst. of Optics). May 1980. Contract AS02-76DP40050. 269p. NTIS, PC A12/MF A01.

Vacuum hot pressing was used to fabricate $CdCr_2S_4$, $CdCr_2Se_4$ and (1-x) $CdCr_2S_4$-x $CdCr_2Se_4$ discs with diameters of 1.25 cm from fine powders and small single crystals to relative densities as high as 99.6%. Optical attenuation coefficients of ~ 1.0 cm^{-1} at 10.6 m were obtained for $CdCr_2S_4$, and values of 12.1 cm^{-1} and 14.9 cm^{-1} for the selenide and sulfur-selenide mixture. Two-and-three-phonon absorption bands were found to limit the transmission of $CdCr_2S_4$ at lambda > 10 μm. Extrinsic absorption mechanisms caused the higher attenuation coefficients in $CdCr_2Se_4$ and the mixture. The main extrinsic mechanisms at long wavelengths were free carrier absorption (in $CdCr_2Se_4$) and an impurity absorption band at 16.3 μm due to Cr_2O_3. At short wavelengths the attenuation coefficient was dominated by scattering from pores and second phases. Free carrier absorption was found to be induced by free selenium present in the starting powders. Suppression of this absorption was achieved by optimizing the hot-pressing procedure in order to remove free selenium. The presence of pores was attributed to incomplete densification arising from the presence of second phases (CdSe and Cr_2Se_3) and the absence of plastic deformation as a densification mechanism. Laser damage thresholds of 250 $MWcm^{-2}$ and 100 $MWcm^{-2}$ were measured at 10.6 μm for $CdCr_2S_4$ and $CdCr_2Se_4$, respectively.

33913 **Numerical methods for analyzing sintering by surface diffusion.** Nickols, F.A. (Argonne National Lab., IL). *Scr. Metall.;* **14**: No. 8, 951-954(Aug 1980).

It is concluded that shape profiles and neck-growth kinetics as previously presented are reasonable. Independent numerical analyses produced (for no shrinkage) profiles and kinetics for cylinders is in agreement. Undercutting volumes about equal to neck volumes are required by conservation. (FS)

STRUCTURE AND PHASE STUDIES

33914 (LBL—10651) **Microstructure and domain structure of PZT.** Goo, E.K.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01.

Thesis.

The microstructure and domain structure of polycrystalline lead-zirconate titanate was studied by TEM. An amorphous phase of ~ 100 A thickness is found at the grain boundaries. The domain structure observed is similar to single crystal $BaTiO_3$. The thickness of the 90°C domain walls is determined to be less than 100 A. ZrO_2 particles are present in the material.

33915 (SAND—80-1838C) **Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking.** McCollister, H.; Van Vlack, L.H. (Sandia National Labs., Albuquerque, NM (USA); Michigan Univ., Ann Arbor (USA)). 1980. Contract AC04-76DP00789. 40p. (CONF-801034—1). NTIS, PC A03/MF A01.

From 33. ACS Pacific Coast meeting; San Francisco, CA, USA (28 Oct 1980).

Lithium aluminosilicate ceramics are altered by acid. Hydrogen is exchanged for lithium in both keatite and high-quartz type materials. The crystal structures of the lithium and hydrogen aluminosilicates are isomorphous, but the unit cells of the latter are smaller. Thus, the H^+-for-Li^+ exchange introduces microcracks. These permit an ingress of acid to the reaction interface and establishes a linear reaction rate. This H^+-for-Li^+ exchange follows the Arrhenius relationship between log reaction depth and reciprocal temperature.

33916 **Si and Ge (111) surface structures after pulsed laser annealing.** Zehner, D.M.; White, C.W.; Ownby, G.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Appl. Phys. Lett.;* **37**: No. 5, 456-459(1 Sep 1980).

Pulsed laser irradiation of (111) oriented single-crystal surfaces of Si and Ge is shown to result in the production of (1 x 1) surface structures as determined by low-energy electron diffraction. These metastable surface structures are obtained in the absence of any stabilizing impurities. The temperature range over which these surface structures are stable has also been determined. These results are compared with those obtained by conventional sputter-anneal treatments.

33917 **Surface-induced ordering of a liquid crystal in the isotropic phase. II. 4-methoxybenzylidene-4'-n-butylaniline (MBBA).** Tarczon, J.C.; Miyano, K. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **73**: No. 4, 1994-1998(15 Aug 1980).

The boundary order parameter of the liquid crystal 4-methoxybenzylidene-4'-n-butylaniline (MBBA) in the isotropic phase has been deduced for several surface treatments by measuring the surface-induced pretransitional birefringence. Results for the silane surface coupling agent, methyl-3-aminopropyltrimethoxy-silane (MAP) were particularly interesting, indicating a negative surface order parameter. An analytic expression for the temperature-dependent birefringence is derived from Landau's expanison in the order parameter. This expression shows that the value of the boundary order parameter determines the absolute minimum isotropic phase temperature.

PROPERTIES

REFER ALSO TO CITATION(S) 33459, 33515, 33912, 33914, 33915, 34250

33918 **Piezooptic coefficients of four neodymium-doped laser glasses.** Waxler, R.M.; Feldman, A. (U.S. National Bureau of Standards, Ceramics, Glass, and Solid State Science Division, Center for Materials Sciences, Washington, D.C. 20234). *Appl. Opt.;* **19**: No. 15, 2481-2482(1 Aug 1980).

The stress-induced birefringence was measured for the phosphate glasses Q-88, LG-812, E-181, and LHG-10. (AIP)

33919 **Comment on "Quantum photoyield of diamond (111): A stable negative-affinity emitter".** Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 1095(15 Jul 1980).

This comment suggests that the conclusions based on measurements on the (111) surface of diamond may be erroneous.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 33888

RADIATION EFFECTS

33920 Reversible changes in the oscillator strengths of Si-H vibrations in a-Si:H induced by He^+-ion bombardment. Oguz, S.; Anderson, D.A.; Paul, W.; Stein, H.J. (Division of Applied Sciences, Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., B: Condens. Matter;* **22**: No. 2, 880-885(15 Jul 1980).

We report measurements of infrared (ir) vibrational absorption made on thin films of rf-sputtered a-Si:H bombarded with 100- and 200-keV He^+ ions, and also after an anneal at temperatures up to 320 °C. We find that the integrated intensities of ir vibrational bands at 2000 and 850 cm^{-1} are enhanced significantly after the bombardment, whereas bands at 2100, 890, and 650 cm^{-1} show little change. Annealing at 320 °C reduces the integrated intensities of the 2000- and 850-cm^{-1} peaks, again with little change in the other peaks, thus reversing the effect of bombardment. We explain these observations in terms of changes in the oscillator strengths of the vibrational modes induced by defects created near the vibrating complex during bombardment. The significance of the dependence of the ir oscillator strengths on the local defect structure and its implications for the interpretations of ir spectra are discussed.

33921 Resonantly enhanced multiphoton ionization and third-harmonic generation in xenon gas. Miller, J.C.; Compton, R.N.; Payne, M.G.; Garrett, W.R. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev. Lett.;* **45**: No. 2, 114-116(14 Jul 1980).

Resonantly enhanced multiphoton ionization signals through the $6s[3/2]J=1$ state of Xe rapidly disappear at pressures above 0.30 torr; concurrently, intense, vacuum-ultraviolet third-harmonic radiation is detected in the forward direction. Laser excitation spectra of the vacuum ultraviolet light exhibit increasing blue shifts and bandwidths with increasing pressure. The observed competition between ionization and third-harmonic generation is discussed in terms of a model involving fast collective emission.

CHEMISTRY

33922 (BNL—50973, pp 7-46) **Chemical Sciences Division.** Metz, D.J. Dec 1978.

In Annual highlights of programs in energy sciences.

The following were studied: porphyrin chemistry; chemistry of energetic compounds; kinetics and mechanisms of chemical processes related to the development and use of energy; combustion studies on alternative fuels; bioelectrochemistry and electrochemistry; molecular structure of porphyrins and photo-energy transducing systems; metal hydrides; chemistry and physics of coal utilization; high-temperature chemistry; catalysis; cyclic separations process research; trace element analysis using synchrotron radiation; determination of fragile molecules in environment; and rotating fluidized bed combustor. A high school teachers' institute on energy is also briefly reported. (DLC)

ANALYTICAL AND SEPARATIONS CHEMISTRY

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 33296, 33304

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 33281, 33308

33923 (UCID—18766) **Comparison assay of a gold plating solution by controlled-potential coulometry and fire assay.** Harrar, J.E.; Waggoner, M.C.; Loy, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Aug 1980. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

A commercial gold-electroplating solution was assayed for its total gold content by two high-precision techniques and the results were compared. The solution was analyzed using controlled-potential coulometry at the authors' laboratory and by the fire assay technique at Metallurgical Laboratories, Inc., of San Francisco. Agreement between the two laboratories was within 0.3% for the total quantity of gold in two containers that were sampled, and within 0.5 to 1.0% for the concentrations of gold in the solutions.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 33296

33924 (AD-A—076964) **Radial distribution least-squares program (RADILS) users manual. Memorandum report.** D'Antonio, P.; Konnert, J.H. (Naval Research Lab., Washington, DC (USA)). 17 Oct 1979. 61p. NTIS, PC A04/MF A01.

A rapidly converging radial distribution least squares program (RADILS) is available for the analysis of x-ray, neutron and electron diffraction data from liquid and amorphous materials. The program automatically generates a radial distribution function, G(r), essentially free from termination effects and determines the empirical background scale and shape, absolute scale factor, bulk density and coordination numbers, disorder parameters and interatomic distances for the first few highly ordered distances in the sample.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 33296, 33304

33925 (DP-MS—80-17) **Direct determination of cesium in pilot plant effluents by isotope dilution mass spectrometry.** Chastagner, P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 25p. (CONF-800837—1). NTIS, PC A02/MF A01.

From Rocky Mountain conference; Denver, CO, USA (11 Aug 1980).

At the Savannah River Laboratory, stable cesium at the part per billion levels is routinely determined in simulated defense waste supernate by isotope dilution mass spectroscopy. This work is in support of pilot plant studies of waste immobilization process. A direct method was developed in which spiked samples of simulated waste supernate are loaded directly on the sample filament.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 33213

33926 (ANL—80-71) **Carrier facilitated transport through membranes.** Kaper, H.G.; Leaf, G.K.; Matkowsky, B.J. (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01.

Facilitated transport is a process whereby the diffusion of a solute across a membrane is chemically enhanced. In this report an analysis is given of a facilitated transport system involving a volatile species A which reacts with a nonvolatile carrier species B to form the nonvolatile product AB. The species A is transported across the membrane by ordinary diffusion, as well as by the diffusion of the product AB. It is assumed that the reaction rates are large, so the reactions are confined mostly to thin boundary layers near the surfaces of the membrane. The method of matched asymptotic expansions is used to derive the asymptotic solution of the nonlinear boundary value problem governing equilibrium. The effect of various parameters on the facilitation factor is analyzed in detail.

33927 (IS-T—910) **Chelating ion exchange with macroreticular hydroxamic acid resins.** Phillips, R.J. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 154p. NTIS, PC A08/MF A01.

Thesis.

The synthesis, reactions, and analytical applications of hydroxamic acids, including chelating resins with this functional group, are reviewed. A procedure for attaching N-phenyl hydroxamic acid groups to Amberlite XAD-4 is described. The extraction of 20 metal ions from 2 M hydrochloric acid by this resin is discussed. Conditions for the quantitative extraction and back-extraction of 9 ions are reported. Results are compared with work on solvent extraction with N-phenylbenzohydroxamic acid. Procedures for attaching N-methyl and N-unsubstituted hydroxamic acid groups to Amberlite XAD-4 are described. The N-phenyl, N-methyl, and N-unsubstituted hydroxamic acid resins are compared with respect to metal-ion complexation. The scope of applications for hydroxamic acid resins is investigated by studying the extraction of 19 metal ions as a function of pH. The resins are especially suitable for the extraction of zirconium(IV), titanium(IV), and uranium(IV) from strongly acidic solution. Aluminum(III) is separated from calcium and phosphate by extraction at pH 4. The use of the resins for the purification of reagents, concentration of trace constituents, and chromatographic separation is demonstrated.

33928 (LA-UR—80-2414) **Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory.** Ramsey, H.D.; Clifton, D.G.; Hayter, S.W.; Penneman, R.A.; Christensen, E.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 21p. (CONF-800814—14). NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Portions of this document are illegible.

Americium recovery was initiated at Los Alamos Scientific Laboratory (LASL) in the late 1940's. The early procedures separated gram quantities of americium from large amounts of impurities including plutonium and the rare earths. Ion exchange procedures were developed for further purification. Until recently, no routine processing of americium has been done at LASL for several years. The increasing demand for americium in oil-well logging instruments and other uses led LASL to develop and install a process to recover larger quantities of americium. The LASL process was developed around the chemistry of americium that had been elucidated both at LASL and at other facilities. Presently, the americium feed is obtained as a by-product from a plutonium purification process at the new plutonium facility at LASL. This feed filtrate from a peroxide precipitation process is precipitated as a slurry of hydroxides, filtered, dissolved in nitric acid, and passed through an anion exchange column to remove any residual plutonium. The americium, contained in the effluent, is precipitated as the oxalate and calcined to the oxide. Americium is also available in other highly salted acidic process streams. These should lend themselves to solvent extraction. Developmental work has been promising, and a dibutyl butyl phosphate-kerosene extraction process is being brought on-line.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 33178, 34343

33929 (CONF-800808—6) **Raman spectroscopy of molten mixtures of lithium and potassium sulfate.** Smith, D.H.; Begun, G.M.; Child, W.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From 7. international conference on raman spectroscopy; Ottawa, Canada (4 Aug 1980).

A broad Raman band at 1100 to 1190 cm^{-1} belonging to $\nu_3(T_2)$ of SO_4^{2-} in a T/sub d/ symmetry has been observed for Li_2SO_4—K_2SO_4 melts. The splitting of ν_3 suggests that SO_4^{2-} experiences a field of lower symmetry, while other features indicate little change in the asymmetry of the environment as Li^+ is replaced by K^+.

33930 (PNL—2579) **Chemistry of technetium in the environment.** McFadden, K.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 22p. NTIS, PC A02/MF A01.

Technetium release to the environment may occur during separation and recovery of spent nuclear fuels, or in disposal of aqueous waste from nuclear facilities, hospitals, or other users. The chemistry and sources of technetium are reviewed as a basis for prediction of its behavior in the environment.

33931 (SAND—80-1642) **Bibliography on shock-induced chemistry.** Graham, R.A.; Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

This bibliography presents a reference list and author index in which the references are categorized by topic. Topical areas covered include: methods of sample recovery, shock activation of catalysts, shock-activated sintering, shock-activated polymerization, miscellaneous organics, modification of polymers, modification of elastomers, inorganic material synthesis and shock-induced electrochemistry. The bibliography includes 110 research papers and 10 review articles. A list of relevant Soviet symposia which discuss shock chemistry is also given.

33932 **Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms.** Macdonald, R.G.; Moore, C.B. (Department of Chemistry, University of California and Materials and Molecular Research Division of the Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 4, 1681-1689(15 Aug 1980).

Total decay rates for HCl(v=2, 1) were measured in the range 294—439 K for Cl, 295—390 K for Br, and at 296 K for H. HCl(v=2) was produced directly by pulsed laser excitation of the overtone. The fraction of HCl(v=2) relaxed to HCl(v=1) was determined. For HCl(v=2) + Cl, relaxation gave entirely HCl(v=1) within an experimental uncertainty of +- 10%, the total relaxation rate was large, k/v-bar≥5 A^2, and rates varied only slightly with temperature. For Br+HCl(v=2) reaction to HBr(v=0) + Cl is exoergic by about kT. Relaxation to HCl(v=1) is the dominant process. Reaction contributes roughly 17% and 34% to the loss of HCl(v=2) at 295 and 390 K, respectively. In contrast to the result for Br and for O(reported previously), H+HCl(v=2) gives 65% H_2+Cl and only 35% HCl(v=1)+H. For HCl(v=1)+H, Cl, O the vibrational excitation energy is greater than the activation energy for reaction. The relaxation rates are between 1/2 and 1/3 of the A values for the measured thermal exchange rates A exp(-ΔE/sub act//RT). For HCl(v=1)+Br, well below threshold, the rate is some 20 times less than for HCl(v=1)+Cl. The rate for HCl(v=2)+Br, just above reaction threshold is not dramatically larger. The ratios of vibrational relaxation rates for HCl(v=2) vs HCl(v=1) are 5.0 +- 1.3, 4.2 +- 0.4, and 5.0 +- 1.3 for O, Cl, and Br, respectively. Any first order linear perturbation treatment gives rates proportional to v; the data scale more closely as v^2.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 33305

33933 **Extraction method of tritium.** Shimizu, M. (to Doryokuro Kakunenryo Kaihatsu Jigyodan). US Patent 4,173,620. 6 Nov 1979. Priority date 27 Dec 1976, Japan, 6p.

An extraction method of a high purity tritium gas from tritium-containing heavy water is disclosed. Tritium-containing heavy water is led from a heavy water source into an exchange reaction column wherein the heavy water is brought into contact with a tritium-containing heavy hydrogen to thereby transfer tritium in the heavy hydrogen into the heavy water by way of the exchange reaction to obtain a tritium-enriched heavy water. The resulting tritium-enriched heavy water is then led to a heavy hydrogen gas generator such as an electrolytic cell to generate a tritium-enriched heavy hydrogen, a part of which is recycled to the exchange reaction column and the remaining part thereof is led into a hot-wire type thermal diffusion column, e.g. cascade to enrich tritium. The thus enriched tritium gas is withdrawn from the thermal diffusion column cascade. The tritium-depleted heavy hydrogen withdrawn from the exchange reaction column is burnt to produce a tritium-depleted heavy water which is then recycled to both the heavy water source and the exchange reaction column.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

33934 (IS-T—909) **Mechanistic study of the hydrogenolysis of neopentane on iridium.** Kinkade, N.E. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 109p. NTIS, PC A06/MF A01.

Thesis.

Reaction of hydrogen and neopentane on iridium films resulted in the production of methane as the only product in the temperature range 403 to 473K. Pressures were varied over the ranges 1 to 400 millitorr for neopentane and 20 to 3000 millitorr for hydrogen. The limiting orders of the reaction with respect to hydrogen were found to be +2.0 and -0.1, and with respect to neopentane were +0.95 and -0.80. The order with respect to the partial pressure of methane was -0.03 or essentially zero. Flash desorption experiments indicated that no hydrocarbons could be desorbed from the sample. Deuterium exchange experiments indicated that once neopentane was adsorbed onto the iridium film at 468K it did not desorb without first undergoing carbon-carbon bond scission. A mechanism involving the reversible, dissociative adsorption of hydrogen and the irreversible, dissociative adsorption of neopentane was proposed. The neopentane dissociates into single carbon atom fragments on the surface and the surface concentrations of these fragments, C*, CH*, CH_2* and CH_3*, and H* vary depending upon the reaction conditions. At neopentane pressures >10 millitorr the surface species CH_3*, CH_3* and H* are predominant, while at neopentane pressures <2 millitorr, the concentration of the CH* species is also significant.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 33178

33935 (AD-A—077110) **Optical extinction and N2 gas evolution on photodecomposition of Pb(N3)2. Final report, 1972-1975.** Garrett, W.; Wiegand, D.A. (Army Armament Research and Development Command, Dover, NJ (USA). Large Caliber Weapon Systems Lab.). Sep 1979. 42p. NTIS, PC A03/MF A01.

The slow decomposition of lead azide single crystals was studied by measurement of changes in optical extinction and N2 gas evolution due to visible, ultraviolet, and x-ray irradiation. Direct comparisons of total N2 evolved and changes in optical density as a function of irradiation time for a given sample allow a simple interpretation of the decomposition processes in terms of simultaneous colloidal lead and N2 formation. Kinetic studies, as a function of wavelength and intensity, further indicate that the rate of decom-

position is simply related to the rate of energy absorption and the amount of decomposition . For weakly absorbed radiation, a monomolecular decomposition process is indicated. The colloidal Pb was found to be, in some cases, highly reactive with air and evidence for Pb metal production was found for irradiation in high vacuum. Evidence for N2 trapping was also observed. Decomposition efficiencies were studied as a function of wavelength and temperature; the thermal stability of the disorder was investigated; and optical bleaching effects were observed. Polarized light measurements of the optical extinction indicate that it is primarily due to absorption by Pb colloids.

33936 Photoelectrochemistry with p-Si electrodes: Effects of inversion. Turner, J.A.; Manassen, J.; Nozik, A.J. (Solar Energy Research Institute Golden, Colorado 80401). *Appl. Phys. Lett.;* **37**: No. 5, 488-491(1 Sep 1980).

Reduction of chemical species with redox potentials above the apparent conduction band edge of p-Si were found to be possible with illuminated p-Si in contact with nonaqueous electrolytes. Analysis of the wavelength dependence of the photoreduction current and capacitance data as a function of electrode potential, ac signal frequency, and light intensity shows that this supra-conduction-band-edge reduction is the result of band-edge unpinning, rather than the result of a hot-electron injection process. The band-edge unpinning is caused by the formation of an inversion layer in illuminated p-Si.

RADIATION CHEMISTRY

33937 (DOE/EV/03221—67) **Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Annual progress report, September 1979-July 1980.** Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). 1980. Contract AC02-76EV03221. 43p. NTIS, PC A03/MF A01.

During this year, emphasis will be given on the properties of HO_2 and O_2^- and OH, mainly in their role in biological systems. We will continue to study and elucidate how O_2^- reacts in biological systems. The toxicity of O_2^- is quite well established but the mechanism is still obscure. One way O_2^- is toxic is that OH is formed from O_2^- through reduction of Fe^{3+}, and subsequently the reaction of Fe^{2+} with H_2O_2 (Fenton reaction). This mechanism is sometimes called the Haber Weiss Reaction. We will study if reduction of Fe^{3+} complexes by O_2^- in biological systems does catalyze the Haber Weiss reaction and if OH is formed in this mechanism. The role of oxygen, radiosensitizers in radiation damage of bacteriophages and cells will be further studied, as well as on E. coli and enzymes. Use of different mutants, such as ones with repair deficiencies, or others which are deficient in glutathione will help to elucidate the role of O_2^- and O_2 toxicity. We will try to elucidate the formation and role of OH, O_2^- and O_2 in these systems as well as the relative contribution of endogenous and exogenous damage, and the role of direct and indirect radiation damage to cells. As there is some doubt how and if SOD protects cells from irradiation as literature results show lots of conflict, we will try to clear this point, in studies with E. coli mutants, and adding SOD endogenously and exogenously. We also intend to study if SOD (super oxide dismutase) does react only with O_2^- or also with biological peroxides (RO_2) and hydroperoxides (RO_2H). Further studies of O_2^- and O_2 with various cytochromes, and hemoglobins is planned.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 34150

33938 Imidazolium tetrachlorodioxouranate(VI), $[C_3N_2H_5^+]_2[UO_2Cl_4]^{2-}$. Perry, D.L.; Freyberg, D.P.; Zalkin, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *J. Inorg. Nucl. Chem.;* **42**: No. 2, 243-245(1980).

The crystal and molecular structure of imidazolium tetrachlorodioxouranate(VI) has been determined by X-ray diffraction methods. The crystals, obtained by reacting imidazole and $UO_2Cl_2.3H_2O$ in hydrochloric acid and maintained at pH = 2.5 to 3.0, are monoclinic, $P2_1/n$. Cell dimensions are given. The structure was refined to a conventional R factor of 0.034 using 1494 data where $F^2 > =(F^2)$. The $[UO_2Cl_4]^{-2}$ anion is octahedral with U-O distance of 1.770 A and U-Cl distances of 2.692 and 2.657 A. The imidazolium cation is planar.

RADIOISOTOPE PRODUCTION

33939 (MLM—2727) **Mound Facility activities in chemical and physical research: July-December 1979.** (Mound Facility, Miamisburg, OH (USA)). 18 Jun 1980. Contract AC04-77DP00053. 56p. NTIS, PC A04/MF A01.

Research is reported in the following fields: isotope separation (Ar, C, He, Kr, Ne, O, Xe), low-temperature research (H intermolecular potential functions, gas analysis in trennschaukel), separation chemistry (^{229}Th, ^{231}Pa, ^{230}Th, ^{234}U), separation research (liquid thermal diffusion, Ca isotope separation, molecular beam scattering, mutual diffusion of noble gas mixtures, lithium chemical exchange with cryptands), and calculations in plutonium chemistry (algorithms, valence in natural water). (DLC)

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

33940 (AD-A—076514) **Combustion diagnostics using laser spontaneous-Raman scattering. Final report, 1 July 1976-31 October 1978.** Yaney, P.P. (Dayton Univ., OH (USA). Research Inst.). Apr 1979. Contract F33615-76-C-2078. 139p. NTIS, PC A07/MF A01.

An existing computer-controlled Raman Spectroscopy system, using a pulsed nitrogen laser and a double spectrometer, was upgraded and used to measure the temperatures in the combustion plume of an afterburning J85-5 turbojet engine. The computer-fitted temperatures had standard deviations between one and three percent. The agreement with simultaneous and sequential gas-sampling probe measurements and with sequential thermocouple measurements was within five percent. Upon completion of these studies, the system was extensively modified for use with a 10-inch diameter combustion tunnel. Forty-eight sets of Raman data were taken over a wide range of operating conditions of the tunnel. The temperatures ranged from 1000 to over 2000 K using methane fuel. The turbulent diffusion flame was characterized by an unsteady appearance and was orange-yellow in color. Poisson standard deviations for 21 of the measurements averaged four percent. Measurements and spectra of the laser-induced and non-laser-induced backgrounds were also obtained and analyzed.

33941 (AD-A—076958) **Chemistry of combustion of fuel-water mixtures. Final technical report.** McHale, E.T.; Skolnik, E.G. (Atlantic Research Corp., Alexandria, VA (USA)). Oct 1979. Contract N00014-78-C-0640. 50p. NTIS, PC A03/MF A01.

An experimental flame study is reported of the nonphysical processes that lead to soot suppression when water is added to fuel. In practical systems water, emulsified into liquid fuels, reduces soot physically by producing improved atomization and also chemically by altering some soot formation process. To investigate the chemical aspects alone, a gaseous laminar diffusion flame was used, which type of system eliminated the physical part of the process. A flame structure study was performed in which complete chemical species, temperature and soot profiles were measured through flames with and without water added. A flame with added nitrogen was also mapped for comparison purposes. The study to date is somewhat incomplete; however, the following result can be reported. It appears that soot reduction by water addition is a results of a lowering of temperature throughout the dark zone of a diffusion flame with accompanying reduction in soot formation rates. Water is more effective in this respect than equivalent amounts of nitrogen, leading to the conclusion that water has a chemical inhibiting effect on some exothermic reactions early in the flame, in addition to its thermal effect.

33942 (COO—3077-162) **Application of an explicit numerical method to a reaction-diffusion system in combustion.** Reitz, R.D. (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). Nov 1979. Contract AC02-76ER03077. 54p. NTIS, PC A04/MF A01.

Numerical methods are applied to one-dimensional unsteady reaction-diffusion equations to seek propagating wave solutions. These equations describe flame propagation in certain combustion systems. It is shown that the steady flame speed is invariant under this coordinate transformation. Model reaction-diffusion equations which admit traveling waves as exact solutions are formulated and one of these is solved. The diffusion terms are differenced using the explicit methods introduced by Saul'yev. Both implicit and explicit techniques for the reaction rate terms are tested. Results indicate that numerical diffusion can reduce accuracy significantly, that numerical dispersion truncation errors can reduce accuracy if they are sufficiently large, and that an accurate representation of the reaction rate in the difference equations is important to retain overall accuracy. One of the explicit methods is also applied to an ozone decomposition flame computation. An adaptive grid procedure is also implemented. Results show good agreement with the fourth order accurate results of Margolis.

ENGINEERING

GENERAL ENGINEERING

REFER ALSO TO CITATION(S) 34386

33943 Stressed mirror polishing. 2: Fabrication of an off-axis section of a paraboloid. Nelson, J.E.; Gabor, G.; Hunt, L.K.; Lubliner, J.; Mast, T.S. (University of California, Berkeley, California 94720). W-7405-ENG-48. *Appl. Opt.;* **19**: No. 14, 2341-2352(15 Jul 1980).

A mirror has been fabricated with the shape of an off-axis section of a paraboloid by grinding and polishing a sphere into a prestressed blank. The applied stresses were then removed allowing the mirror to spring into the desired paraboloidal shape. The 36-cm diam off-axis section deviated 9.9-μm rms from the polished sphere. The final surface deviated 0.03-μm rms from the desired off-axis section.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 33740, 33871

33944 (BDX—613-2300) **Inspection considerations for holes 0.040 inch and smaller.** (Bendix Corp., Kansas City, MO (USA)). Mar 1980. Contract AC04-76DP00613. 27p. NTIS, PC A03/MF A01.

The accurate inspection of hole size and location for holes smaller than 0.040 inch necessitates several considerations beyond those normally encountered for larger holes. The technical aspects are described herein.

33945 (BDX—613-2373) **Deburring: technical capabilities and cost-effective approaches, Lessons 3 and 4.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 75p. NTIS, PC A04/MF A01.

This ten lesson text on deburring is designed to provide engineers and production supervisors with an overall understanding of deburring economics and current capabilities. The material included describes economics, side effects, process selection techniques, product design influences, standards, plantwide approaches, burr formation, and prevention. Deburring methods described include barrel, centrifugal barrel, vibratory, spindle, manual, electrochemical, electropolish, brush, abrasive jet, abrasive flow, water jet, thermal energy, and mechanized mechanical. Lessons 3 and 4 describe product design influences and burr prevention and minimization respectively.

33946 (BDX—613-2401) **Preliminary study of high-speed machining.** Jordan, R.E. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 99p. NTIS, PC A05/MF A01.

The feasibility of a high speed machining process has been established for application to Bendix aluminum products, based upon information gained through visits to existing high speed machining facilities and by the completion of a representative Bendix part using this process. The need for an experimental high speed machining capability at Bendix for further process evaluation is established.

33947 (BDX—613-2421) **Deburring: technical capabilities and cost-effective approaches, Lessons 9 and 10.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 54p. NTIS, PC A04/MF A01.

Abrasive jet, water jet, and abrasive flow deburring are not panaceas for the world's deburring problems. They do, however, solve many of the problems where burrs are either difficult to reach or amenable to automation. As seen in this lesson, they can deburr miniature parts as well as large parts. In almost every case; however, one will note that accessibility of the burr is the key to the success of these processes. Volumes have been published on the effects of abrasive jet parameters. The reader is encouraged to pursue some of the citations in the Source of Additional Information for further quantitative information. Similarly, data on abrasive flow deburring is also available. Little data, however, has been published on water jet deburring.

33948 (IS-T—928) **Stress concentration factors due to flaws near the edge of a plate under tension.** Hanus, J.B. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 62p. NTIS, PC A04/MF A01.

Thesis.

The primary goal of this research was to determine how flaws near an edge relate to structural reliability. The effect of ligament fracture for circular and elliptical holes was examined and the resulting surface breaking flaw and its relationship to a standard U-shaped notch were investigated using photoelastic techniques.

33949 (SAND—80-0481) **Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities.** Adams, P.H.; Ault, R.L.; Fulton, D.L. (Sandia Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 183p. NTIS, PC A09/MF A01.

This report outlines the capabilities and limitations of the two centrifuges and gives other details which must be considered in preparing test specifications and designing fixtures, gives the theory and terminology of centrifuge testing, and describes the layout, operating principles, support functions, and reference material for each facility.

33950 (SAND—80-0697) **Sandia Laboratories hybrid computer and motion simulator facilities.** Curry, W.H.; French, R.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01.

Hybrid computer and motion simulator facilities at Sandia National Laboratories include an AD/FIVE-AD10-PDP11/60, an AD/FIVE-PDP11/45, an EAI7800-EAI640, an EAI580/TR48-Nova 800, and two Carco S-45OR-3/R-493A three-axis motion simulators. An EAI680 is used in the analog mode only. This report describes the current equipment.

33951 (SAND—80-1315C) **Improved recursive formula for calculating shock response spectra.** Smallwood, D.O. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 16p. (CONF-801033—1). NTIS, PC A02/MF A01.

From Shock and vibration symposium; San Diego, CA, USA (21 Oct 1980).

Currently used recursive formulas for calculating the shock response spectra are based on an impulse invariant digital simulation of a single degree of freedom system. This simulation can result in significant errors when the natural frequencies are greater than 1/6 the sample rate. It is shown that a ramp invariant simulation results in a recursive filter with one additional filter weight that can be used with good results over a broad frequency range including natural frequencies which exceed the sample rate.

33952 (SAND—80-1380C) **Application of ultrasonics to space shuttle tiles.** Zimmerman, R.M.; Hogenson, P.A. (Sandia Labs., Albuquerque, NM (USA); Rockwell International Corp., Downey, CA (USA). Space Systems Group). 1980. Contract AC04-76DP00789. 7p. (CONF-801021—1). NTIS, PC A02/MF A01.

From ASNT fall conference; Houston, TX, USA (6 Oct 1980).

Two types of discrete sized ceramic tiles bonded to the outer skin of space vehicles are used for the thermal protection of the Space Shuttle during reentry. Failure of any one of the more than 30,000 tiles on the Space Shuttle could have significant effects. Ultrasonic testing to establish the soundness of the Space Shuttle tiles was evaluated and found to be a viable and valuable method. The method is simple, quick, and has a statistical basis. The testing method involves comparing the measured velocities of finished tiles to velocity-tensile strength relationships obtained for coupons. Acceptance criteria can be developed for the computerized data collection and the status of the tile determined automatically. The method was instituted after many tiles were in existence. It is planned that the method be used to determine tile material quality before any machining or finishing is done in an effort to make the system more efficient. (LCL)

33953 (SAND—80-1482) **Analysis of measurements based on singular value decomposition.** Hanson, R.J.; Norris, M.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

The problem of maintaining quality control of manufactured parts is considered. This involves matching points on the parts with corresponding points on a drawing. The difficulty in this process is that the measurements are often in different coordinate systems. Using the assumption that the relation between the two sets of coordinates is a certain rigid transformation, an explicit least squares solution is obtained. this solution requires the singular value decomposition of a related matrix. Other topics in the paper include an appropriate angular representation of the resulting orthogonal transformation matrix, and a computational algorithm for the various required quantities.

33954 (SAND—80-1534) **Swept narrow band random on random.** Mercer, F.T. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01.

The implementation of swept narrow band random on random on the HP5451C Fourier Analyzer System and the HP5427A Vibration Control System is discussed. Up to five narrow bands of a dynamically changing narrow band random spectrum can

be super-imposed on a broad band random spectrum and swept at various rates to simulate field environments.

33955 (SAND—80-1877C) **Transient response of a single-edge crack in an elastic half-plane.** Chen, E.P. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 15p. (CONF-800846—1). NTIS, PC A02/MF A01.

From US-Greece symposium on mixed mode crack propagation; Athens, Greece (18 Aug 1980).

The elasto-dynamic response of a single-edge crack in a semi-infinite elastic medium is considered in this study. The crack is assumed to appear suddenly in an elastic half-plane that is being stretched by a remote stress field. Near the crack, the interactions between the wave emanating from the tip and those reflected from the free edge take place. This investigation focuses its attention on the determination of the effect of this interaction on the stress intensity factor. Laplace and Fourier transforms are used to reduce the solution to a pair of dual integral equations. A numerical Laplace inversion procedure is used to obtain the time dependence of the solution. Numerical results on the dynamic stress intensity factor are obtained and are presented in a graphical form.

33956 (TAC-HP—80-001) **Heat pipe technology: a bibliography with abstracts. Quarterly update, January-March 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1980. 92p. University of New Mexico, Albuquerque, NM.

A bibliography of 111 citations on heat pipe technology, including a large number of citations on heat pipe uses in energy conservation and solar energy, is presented as a first quarter 1980 update in the Heat Pipe Technology Bibliographic series. (LCL)

33957 (UCRL—83559) **Computer design of a high explosive velocity augmented kinetic energy penetrator.** Tuft, D.B.; Murphy, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1980. Contract W-7405-ENG-48. 25p. (CONF-801003—4). NTIS, PC A02/MF A01.

From Symposium on computational methods in nonlinear structural and solid mechanics; Washington, DC, USA (6 Oct 1980).

The results of a combined analytical experimental design of a high-explosive velocity-augmented kinetic energy penetrator are presented. The objective of the analysis is the design of a velocity augmentor and main charge case. The augmentor design must conform to restrictive volume constraints and provide maximum impulse to the main charge which, in turn, must survive the augmentor loading and penetrate the target. An explicit finite element hydrodynamic computer code, DYNA2D, employing arbitrary zoning, two-way sliding with gaps, and high explosive equation-of-state is employed as the analytical tool. High strain rate material models are used and predictions are compared to experimental deformations. Shock wave interactions in the main charge case are analyzed and a combination of shock attenuation and wave trapping is employed to reduce loads below failure limits. The final design provides maximum velocity augmentation while staying within volume constraints and maintaining main charge case integrity. Computed deformations and velocities are experimentaly verified. This design analysis method using state-of-the-art code and computer capabilities is shown to be an effective method of simplifying the design process as well as providing necessary design optimization data not previously available.

33958 (SAND—80-6016) **Bridge cutout.** Maresch, O.; Viehboeck, F. Jul 1980. Translation of . Austrian Patent 185,885. 6p. NTIS, PC A02/MF A01.

The subject of Main Patent No. 180,993 is a bridge cutout for automatic short-circuiting of series-connected incandescent lamps that have become defective. In this bridge cutout, the two electrodes are bridged by a thermite mixture, possibly with the addition of a binder, which thermite mixture, upon the occurrence of a certain voltage difference on the two electrodes, forms the metal required to short-circuit the electrodes by an exothermic chemical reaction.

33959 (SAND—80-6017) **Bridge cutout, in particular for incandescent lamps to be connected in series.** Maresch, O.; Viehboeck, F. Jul 1980. Translation of . Austrian Patent 180,993. 8p. NTIS, PC A02/MF A01.

This patent is concerned with the design of a bridge cutout for electrical devices to be connected in series, in particular incandescent lamps and is characterized by the fact that its electrodes are bridged by a thermite mixture, possibly with the addition of a binder, from which the metal required to short-circuit the electrodes is formed by an exothermic chemical reaction in the case of operation, that is, upon the occurrence of a certain voltage difference on the two electrodes. The bridge cutout is characterized by the fact that: as reducing agent for the metal oxide or the metal oxides, the mass contains one or more elements of groups I to IV of the periodic system, for example, aluminum, magnesium, zirconium, and so forth; a binder is added to the reacting substances, which binder simultaneously acts as fluxing agent for the welding together or soldering together of the electrodes that occurs in the case of operation; the distance between the electrodes at the point of bridging is selected so small (for example, as 1 mm) that the short-circuiting is insured even when the surface tension of the metal formed is taken into account; the binder additive is selected in such a way that the desired threshold voltage results; and the mass consists of roughly 10 wt. % aluminum 45% NiO, and 45% waterglass (density 1.38).

33960 **Annual research summary, July 1, 1979-June 30, 1980.** West Lafayette, IN; Purdue University (1980). 223p. (NP—25040).

This document summarizes the research activities within the School of Electrical Engineering of Purdue University. It is intended as a reference document for colleagues, prospective graduate students, and organizations interested in electrical engineering research. The research project summaries are organized according to the eight technical areas into which the Purdue electrical engineering graduate program is divided for administrative purposes. These areas are: automatic controls, bioengineering, circuits and systems, communications, computers and automata, electromagnetic fields and quantum electronics, energy sources and systems, and solid state devices and materials. There is also a section devoted to Engineering Education. The research and educational facilities that are available, the recent publications by the staff, and the external funds that support the activities are described in the Appendices.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

33961 **Future trends in superconductive electronics, (Charlottesville, 1978).** Deaver, B.S. Jr.; Falco, C.M.; Harris, J.H.; Wolf, S.A. (eds.). New York, NY; American Institute of Physics (1978). 506p. (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Sixty-three papers were presented at the meetings. A separate abstract was prepared for each of 59 papers. Four papers appeared previously in Energy Research abstracts.

33962 **Rf SQUIDs: the state of the science.** Giffard, R.P. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 11-21(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The theory of rf SQUID operation, including the effects of fluctuations, is discussed. The theory is in agreement with the large signal and small signal behavior of real devices under optimum conditions. The noise levels of many existing rf SQUID systems are substantially above those predicted on the basis of amplifier noise temperatures. All rf SQUIDs seem to exhibit excess noise of unknown origin at low input frequencies. The limitations of devices and future directions of development are considered.

33963 **Present status and future of the dc SQUID.** Ketchen, M.B. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY); Clarke, J.; Goubau, W.M. *AIP Conf. Proc.;* No. 44, 22-27(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A simple theory of the tunnel junction dc SQUID shows that the energy resolution per Hz with respect to an input coil is of order 4k/sub B/T(πLC)/sup 1/2//α^2, where C is the capacitance of each junction and α is the coupling coefficient between the input coil and the SQUID inductance L. The dc SQUID with junction areas of about 10^4 μm^2 has a typical energy resolution per Hz of 7×10^{-30} JHz^{-1}. If the junction area is reduced to 10^2 μm^2 or 1 μm^2, the energy resolution per Hz is expected to improve by one or two orders of magnitude respectively. Further improvement should result from lowering the operating temperature.

33964 **Application of SQUIDs to low temperature transport physics.** Garland, J.C. (Ohio State Univ., Columbus). *AIP Conf. Proc.;* No. 44, 37-48(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

In a little over ten years, the senstivity of low temperature transport experiments has increased from 10^{-9}V to 10^{-15}V. This increase in resolution, made possible by the development of SQUID voltmeters, has spawned several new avenues of research, such as the study of the interface resistance between superconducting and normal boundaries, and the study of transport effects in inhomogeneous superconductors near the percolation threshold. In addition, other research areas have become revitalized, as previously well established theories were found unable to withstand the scrutiny of ultra-high resolution measurements. The study of thermoelectricity in pure metals has developed rapidly during the decade, and new experimental techniques have been devised with resolution comparable to the best resistivity measurements.

33965 **SQUIDs for measuring the magnetic properties of materials.** Deaver, B.S. Jr.; Bucelot, T.J.; Finley, J.J. (Univ. of Virginia,

Charlottesville). *AIP Conf. Proc.;* No. 44, 58-72(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

SQUID magnetometers in conjunction with superconducting magnets and shields are now being used for susceptometers that provide unique combinations of sensitivity, speed, resolution, accuracy, stability and convenience. They are being integrated into systems with automated data acquisition and closed cycle helium refrigerators. These systems promise to become increasingly important for measurements of the magnetic properties of materials.

33966 Application of SQUIDs to measurements in fundamental physics. Cabrera, B. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 73-86(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Several experiments applying SQUID instrumentation to the study of diverse fields in fundamental physics are reviewed. Included from gravitational physics research are the relativity gyroscope experiment, an equivalence principle experiment and work on second generation gravitational wave detectors. Experiments studying the properties of elementary particles at rest include the He^3 nuclear gyroscope, fractional electric charge detector and a magnetic monopole charge detector, where new preliminary measurements on the magnetic charge of the fractional electric charge candidates are presented. Measurements of 2e/h and h/m/sub e/ are included as significant contributions to the determination of the fundamental physical constants. In addition, a brief description of ultra-low magnetic field shields used in four of these experiments is given.

33967 SQUIDs and magnetotellurics with a remote reference. Clarke, J.; Gamble, T.D.; Goubau, W.M. (Lawrence Berkeley Lab., CA). *AIP Conf. Proc.;* No. 44, 87-94(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Two 3-axis SQUID magnetometers were used to perform simultaneous magnetotelluric measurements at two sites separated by 4.8 km near Hollister, California. The data obtained at each site were analyzed by using a standard least-squares method, and also using the two magnetic field measurements at the other site as a lock-in reference. The apparent resistivities obtained from the conventional analysis were nearly always biased downward by noise picked up in the magnetic channels, at some frequencies by as much as two orders of magnitude. By comparison, the same data analyzed with the remote reference technique showed no such bias.

33968 Measurements of magnetic gradients from ocean waves. Podney, W.; Sager, R. (Physical Dynamics, Inc., La Jolla, CA). *AIP Conf. Proc.;* No. 44, 95-105(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The unprecedented sensitivity of superconductive magnetic gradiometers affords means of measuring fluctuating gradient of magnetic fields from eddy currents generated by ocean waves moving seawater across the earth's magnetic field. Our aim was to tell wave spectra from measurements of fluctuating magnetic gradients over oceans. As a first step in development of requisite experimental and analytical techniques, measurements are reported of fluctuating magnetic gradients from surface waves passing an oceanographic research tower located about one mile off Mission Beach near San Diego, California, in 18m of water. The measurements give experimentally-determined frequency response functions for gradients that substantially confirm response functions calculated using Ampere's law. Before making measurements over an open ocean from aircraft, however, means of continually maintaining magnitudes of gradiometer imbalance less than 10^{-6} m^{-1} are required. Development of methods and techniques for suppressing noise from aircraft platforms at frequencies of ocean waves as well as as radio frequencies, and for constructing cryostats suited to aircraft, are presently of secondary importance.

33969 Biomedical applications of SQUIDs. Williamson, S.J.; Brenner, D.; Kaufman, L. (New York Univ., New York). *AIP Conf. Proc.;* No. 44, 106-116(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

SQUID magnetic field detectors are currently used in nearly a dozen laboratories in the United States and Europe to study biomagnetic fields produced by various organs of the human body. Some of the more promising findings of clinical and fundamental interest are briefly reviewed. Emphasis is placed on which technological improvements in the performance of SQUID systems may prove beneficial in future biomedical applications.

33970 Use of SQUIDs in low-frequency communication systems. Nisenoff, M. (Naval Research Lab., Washington, DC). *AIP Conf. Proc.;* No. 44, 117-129(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Antennas employing SQUID amplifiers can be used as relatively compact, highly sensitive receiving elements in communication systems operating in the frequency range from the ULF band (below 30 Hz) up through the HF band (3 to 30 MHz). Antenna elements operating in this frequency region tend to be small compared to the wavelength of interest and thus are poorly matched to the radiation field. Furthermore, their response is often limited by the input noise of the amplifier connected across it. However, a combination of small antenna elements and SQUID amplifiers, which can have noise temperatures lower than 10^{-3}K, could result in receiving antennas with superior noise characteristics compared to conventional ones. A submarine towed ELF (30 to 300 Hz) antenna using SQUID devices, for which preliminary design and development work has been performed at NRL, will be described in some detail. Several other potential applications for SQUIDs in low-frequency communications systems will be outlined. Some performance limitations of current SQUID systems are identified, and recommendations made on how to improve the performance of future SQUID systems.

33971 Commercial superconducting SQUID systems. Goree, W.; Philo, J. (United Scientific Corp., Mountain View, CA). *AIP Conf. Proc.;* No. 44, 130-134(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The SQUID-based instrument's market is well-developed with a commercially-available line of instruments covering measurements from geophysical surveying to medical diagnostics. The major limitation to increased use of these instruments is not technological but rather lack of awareness by potential users, need for product evolution in appearance and ease of use, and the requirements for liquid helium.

33972 SQUID signal strength versus frequency - some surprises. Peters, R.A. (Catholic Univ. of America, Washington, DC); Wolf, S.A.; Rachford, F.J. *AIP Conf. Proc.;* No. 44, 135-139(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Measurements of SQUID signal strength as a function of frequency, obtained with a single probe having constant rf coupling, are reported here. Signal strength is found to be proportional to frequency from 20 MHz to 400 MHz. Between 400 MHz and 1500 MHz, signal strength remains approximately constant. This saturation coincides with an increase in the rf critical current of the SQUID, suggesting that an enhancement of the energy gap of the weak link may be associated with a degradation of the Josephson junction response.

33973 Analytic study on the influence of the weak link parameters on the resonant circuit of the nonhysteretic rf SQUID ($W \leqq 10^5$ s^{-1}). Luebbig, H. (Institut Berlin, Germany). *AIP Conf. Proc.;* No. 44, 140-144(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

An analytic expression for the ac impedance of a one-junction SQUID is derived for the nonhysteretic mode of operation. This impedance involves completely the nonlinear influence of the weak links' current phase relationship on the driving resonant circuit.

33974 Optimization of SQUID differential magnetometers. Wikswo, J.P. Jr. (Vanderbilt Univ., Nashville, TN). *AIP Conf. Proc.;* No. 44, 145-149(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Design criteria for SQUID differential magnetometers are outlined and several measures of instrument sensitivity are presented. Various magnetometer configurations are compared.

33975 Application of a microwave biased rf-SQUID-system to investigate magnetic after-effects. Rogalla, H.; Heiden, C. (Universitat Gieben, Germany). *AIP Conf. Proc.;* No. 44, 150-154(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

For the investigation of magnetic after-effects in superconductors low-drift high-resolution magnetization measurements are required. An rf-biased (9 GHz) closed-loop SQUID-system was developed for this purpose having a slew rate of 2.10^{+7} phi_0/s and a dynamic range of 1400 phi_0. The upper limit for a possible drift referred to the input of the used flux transformer is 3 $\mu T/h$. This low drift and fast response allows registrate magnetization curves over time periods of the order of 10^3 s even under the presence of spontaneous magnetization changes (flux jumps). This system was used in combination with a microprocessor controlled-precision generator for the magnetic field to study the behavior of periodically swept minor hysteresis loops of superconducting vanadium samples.

In general the observed loops are not stationary but exhibit a more or less pronounced creep effect that can be approximated by a logarithmic dependence on the number of minor hysteresis cycle. For sufficient low rates of change of the magnetic field ($dH/dt < 20$ A/cms) a dependence of the creep effect on the total measuring time could not be observed. Contradictory to a solely thermal activated flux creep is also the fact that flux density gradients inside the investigated specimens tend to increase with the number of swept cycle.

33976 Development of a London moment readout for a superconducting gyroscope. Anderson, J.T.; Clappier, R.R. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 155-160(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A gyroscope for verifying certain predictions of General Relativity is under development at Stanford. A method of measuring the gyroscope orientation based on the use of the London moment and a SQUID magnetometer is described. It is estimated that the required sensitivity of 1 milliarc-sec can be achieved in a bandwidth of 2.5×10^{-6} Hz.

33977 Signal detection in 1/f noise of SQUID magnetometers. Cabrera, B.; Anderson, J.T. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 161-165(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

It is shown that the variance on the SQUID power spectrum in the 1/f low frequency region is well behaved, i.e., any small frequency band may be treated as white noise in standard power spectrum estimation theory. Specifically we have taken a calibration signal at 0.017 Hz with an equivalent energy referred to the SQUID input coil of 1×10^{-30} J and digitally recorded and analyzed a record of 140 h duration obtaining an optimum S/N better than 400. The results are in good agreement with theory. In addition, no deviation from the 1/f dependence of the noise energy spectrum down to frequencies below 10^{-5} Hz was observed. A commercially available SQUID and electronics system was used.

33978 Superconducting gravity gradiometers. Paik, H.J.; Mapoles, E.R.; Wang, K.Y. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 166-170(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Two types of superconducting gravity gradiometers have been developed. Both employ superconducting test masses suspended by niobium diaphragms whose motions modulate persistent currents in superconducting loops. A current signal proportional to the gravity gradient is detected by a 19 MHz SQUID. The balancing of common acceleration has been verified experimentally for both systems. A gradient sensitivity better than 2×10^{-10} s^{-2} Hz/sup -1/2/ with a baseline of 10 cm is expected of these gradiometers.

33979 Future of superconducting instruments in metrology. Sullivan, D.B. (National Bureau of Standards, Boulder, CO); Holdeman, L.B.; Soulen, R.J. Jr. *AIP Conf. Proc.;* No. 44, 171-181(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Superconductivity has played a major role in the development of useful new methods for standards and measurements, particularly for dc and high-frequency instruments and for thermometry. Future activities in this field including the development of commercial instruments, the improvement of devices for standards laboratories and the adaptation of some of these systems to small refrigerators are discussed.

33980 Prototype for a commercial Josephson-effect voltage standard. Holdeman, L.B.; Field, B.F.; Toots, J.; Chang, C.C. (National Bureau of Standards, Washington, DC). *AIP Conf. Proc.;* No. 44, 182-186(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A prototype commercial voltage standard is described in which a Josephson junction is used as a precise frequency-to-voltage converter. The ratio of the induced voltage to the applied frequency is an integral multiple of the magnetic flux $Phi_0 = h/2e$, where h is Planck's constant and e is the elemental charge. A constant-voltage step is induced in the current-voltage characteristic of a Josephson tunnel junction by irradiating the junction with microwaves of known frequency. A specially designed potentiometer is used to scale the junction voltage up to 1.017+ V for calibrating Weston-type cadmium-sulfate standard cells. Although cost, simplicity, and ease-of-use considerations necessitated some tradeoff with precision, the instrument nevertheless has an overall accuracy (2σ) relative to the NBS volt of 0.4 ppm or better.

33981 Higher standard voltage generated by multiple Josephson junctions. Koyanagi, M.; Endo, T.; Nakamura, A. (Electrotechnical Lab., Tokyo, Japan). *AIP Conf. Proc.;* No. 44, 187-191(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Preliminary experiments have been performed to obtain a higher standard volt with ten tunnel junctions connected in series. A bias microwave source is used. The microwave power at each junction has to be controlled as closely as possible. Parameters and conditions for the microwave coupling are discussed. The voltage obtained is 55.5 mV at present, but no serious obstacles can be seen for obtaining voltages higher than 100 mV.

33982 Superconducting resonators: high stability oscillators and applications to fundamental physics and metrology. Stein, S.R. (National Bureau of Standards, Boulder, CO); Turneaure, J.P. *AIP Conf. Proc.;* No. 44, 192-213(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA USA (23 Mar 1978).

Superconducting oscillators have achieved better frequency stability than any other device for averaging times of 10 l.c.s. to 1000 l.c.s. This high stability results from the use of solid niobium resonators having Q factors greater than 10^{10}. Such oscillators have direct applications as clocks and spectrally pure sources. They may also be used for accurate measurements of many physical quantities and to perform a variety of experiments on fundamental constants, relativity, and gravity waves.

33983 Biasing for precise frequency in a frequency-agile Josephson junction. Daniel, M.R.; Ashkin, M.; Janocko, M.A. (Westinghouse Research and Development Center, Pittsburgh, PA). *AIP Conf. Proc.;* No. 44, 214-218(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Analog computer studies of a Josephson junction show that the microwave-induced steps in the dc current-voltage curve may be used as ideal (zero impedance) voltage sources with which to bias a second junction. Biased on one of these steps, the second junction is a microwave oscillator of precisely determined frequency. Because the biasing junction impedance $\rightarrow 0$ on a step, it contributes no noise to this second junction. A conceptual design using Dayem bridges fabricated as an integral part of a coplanar waveguide structure is proposed.

33984 Superconducting microstrip filters. Davidheiser, R.A. (TRW Systems, Redondo Beach, CA). *AIP Conf. Proc.;* No. 44, 219-222(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Control of the non-zero radiation resistance inherent in metal strip transmission lines results in high-current densities and low-transmission quality factors. Superconducting metals reduce the ohmic losses to approximately the dielectric losses associated with a sapphire substrate. Quality factors of 100,000 are possible. Applications of this effect in communication systems are discussed for the cases of resonant filters and frequency sources.

33985 Millimeter wave superconducting devices. Richards, P.L. (Univ. of California, Berkeley). *AIP Conf. Proc.;* No. 44, 223-229(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Significant progress has been made during the past two years in the development of millimeter wave superconducting devices. The present status of bolometric detectors and mixers, Josephson-effect mixers, quasiparticle mixers, and Josephson-effect parametric amplifiers will be reviewed.

33986 Josephson mixers at submillimetre wavelengths: present experimental status and future developments. Blaney, T.G. (National Physical Lab., Teddington, Great Britian). *AIP Conf. Proc.;* No. 44, 230-238(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The use of Josephson mixers with an external local oscillator for sensitive heterodyne reception at submillimetre wavelengths is discussed. Recent experiments, primarily at 450 GHz (0.66 mm wavelength), together with our present theoretical knowledge, allow realistic estimates of future receiver performance to be made. Although some practical problems remain, the probability of building field-usable receivers with very competitive sensitivity now appears good. A discussion is also given of the use of the high-harmonic mixing properties of Josephson devices for frequency measurement in the far infrared.

33987 Mixing with Josephson junctions in the far infrared. Adde, R.; Vernet, G. (Universite Paris-Sud, France). *AIP Conf. Proc.;* No. 44, 239-245(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The main problems encountered in order to realize a heterodyne mixer in the far-infrared (≈ 1 THz) are surveyed: junction characteristics, optimum performance, coupling efficiency at the signal and i.f. frequency.

33988 Microwave parametric amplifiers using externally pumped Josephson junctions. Soerensen, O.H.; Mygind, J.; Pedersen, N.F. (Technical Univ. of Denmark, Lyngby). *AIP Conf. Proc.;* No. 44, 246-253(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Externally pumped parametric amplifiers are discussed. Theory and experiments on the singly degenerate parametric amplifier based on a Josephson junction are presented. Advantages and limitations of the singly degenerate and doubly degenerate parametric amplifiers are discussed. Some plans and proposals for future research are presented.

33989 Phase instability noise in Josephson junctions. Chiao, R.Y. (Univ. of California, Berkeley); Feldman, M.J.; Peterson, D.W.; Tucker, B.A.; Levinsen, M.T. *AIP Conf. Proc.;* No. 44, 259-263(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Noise phenomenon seen in microbridge SUPARAMPs is explained in terms of phase instability in the junction voltage waveform associated with rf-induced nulls in the supercurrent. It is shown that the same instability occurs between all rf-induced steps. Experimental verification is presented.

33990 Differential heterodyne frequency conversion at 0.4 mm wavelength. Ulrich, B.T. (Univ. of Geneva, Switzerland); van der Heijden, R.W.; Verschueren, J.M.V. *AIP Conf. Proc.;* No. 44, 264-268(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A Josephson-effect differential heterodyne receiver converts a variable signal frequency f/sub S/, near a fixed local oscillator f/sub L/, to a fixed intermediate frequency f/sub I/ = f/sub S/ - f/sub L/ - f/sub Q/, by mixing between f/sub D/ = f/sub S/ - f/sub L/ and a voltage-tunable variable quantum oscillation f/sub Q/ = 2eV/h provided by a double-junction resistive interferometer. At f/sub L/ = 0.7 THz provided by a far infrared formic acid laser, with f/sub S/ = f/sub L/ + f/sub D/ provided by a Doppler shift, power conversion efficiencies n/sub Q/ from f/sub D/ → f/sub I/ up to 0.2 were observed. Linewidths of the quantum oscillation δf/sub Q/ — (2k/sub B/T/πL)/sup 1/2/ (2eR/h) down to — 0.5 Hz were observed for R = 3.3 x 10^{-9} Ω interferometer resistance, and L — 10^{-9} H interferometer inductance, demonstrating an intrinsic frequency resolution of 1 in 10^{12} at high conversion efficiency for the technique.

33991 Junctions - types, properties, and limitations. Tinkham, M. (Harvard Univ., Cambridge, MA). *AIP Conf. Proc.;* No. 44, 269-279(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The types of Josephson junctions are surveyed, with emphasis on tunnel and constriction configurations as limiting examples. The limits on the intrinsic high-frequency performance set by capacitive and heating effects are analyzed theoretically, and the latter compared with experimental data on VTB's and point contacts. Nonequilibrium effects more subtle than those accounted for by simple heating are briefly considered. Finally, the properties of point contacts which apparently show nearly ideal intrinsic frequency-dependent behavior out to far infrared frequencies of twice the gap frequency are summarized.

33992 Advanced imaging techniques for submicrometer devices. Blocker, T.G.; Watts, R.K.; Holton, W.C. (Texas Instruments Inc., Dallas). *AIP Conf. Proc.;* No. 44, 280-288(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

As the dimensions of electronic circuits are reduced in the quest for higher performance and greater density, the limits of conventional imaging techniques are being reached. New imaging methods using electron beams and x-rays rather than optical radiation are being developed in many laboratories. An overview is given of work in a laboratory on high resolution electron beam and x-ray lithography. The GaAs field effect microwave transistor is highlighted as an example of a device for which the increased cost of advanced imaging techniques is offset by the enhanced performance obtained.

33993 High resolution electron beam lithography and applications to superconducting devices. Broers, A.N.; Laibowitz, R.B. (IBM Thomas J. Watson Research Center. Yorktown Heights, NY). *AIP Conf. Proc.;* No. 44, 289-297(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

High resolution electron beam lithographic techniques are esssential for the fabrication of a wide variety of present and future electronic devices and integrated circuits. Advanced structures have been made for silicon, bubble and superconducting technologies. The e-beam lithography techniques used to obtain the highest possible resolution will be reviewed and recent results using electron-beam produced contamination layers are also presented. These high resolution techniques have been used to make superconducting Nb nanostripes with widths of 25 to 50 nm. The I-V characteristics for these bridges will be presented along with transmission electron micrographs of the structures.

33994 Fabrication of microbridge Josephson junctions using electron beam lithography. Lukens, J.E.; Sandell, R.D.; Varmazis, C. (State Univ. of New York, Stony Brook). *AIP Conf. Proc.;* No. 44, 298-311(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The fabrication of microbridge Josephson junctions using a small research-oriented electron beam lithography system is described. Data is presented on the dimensional dependence of the resistance and critical current of such junctions. Progress toward the development of large coherent arrays of these junctions and the potential properties of such arrays is discussed.

33995 Alternatives in fabricating submicron niobium Josephson junctions. Daalmans, G.M.; Zwier, J. (Univ. of Technology, Delft, Netherlands). *AIP Conf. Proc.;* No. 44, 312-316(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The fabrication of submicron niobium microbridges and submicron niobium tunneljunctions is discussed. Several techniques are described to fabricate niobium microbridges. The most important of them is a technique in which niobium is evaporated through a bakable submicron mask. The technique to fabricate submicron tunneljunctions is basically a shadow evaporation technique. In contrast to earlier attempts it is a reproducible method suitable for large scale application.

33996 Fabrication of submicron Josephson microbridges using optical projection lithography and liftoff techniques. Feuer, M.D.; Prober, D.E.; Cogdell, J.W. (Yale Univ., New Haven, CT). *AIP Conf. Proc.;* No. 44, 317-321(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The fabrication of sub-micron, type II microbridges, using a reflected-light microscope for high-resolution, projection photolithography and metal liftoff techniques for precise pattern transfer is described. Microbridges as narrow as 2000 A have been produced. The novel technique of through-the-substrate exposure, which gives extremely sharp edge definition, is discussed, as well as other factors determining resolution and liftoff yield. Experimental results are presented for a 0.2 μm wide Pb/sub 0.86/In/sub 0.14/ microbridge with a device resistance of 5.5 Ω. Finally, the general applicability of these fabrication techniques is considered.

33997 Superconducting microbridges and arrays. Lindelof, P.E.; Bindslev Hansen, J.; Jespersen, P. (Univ. of Copenhagen, Denmark). *AIP Conf. Proc.;* No. 44, 322-326(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The current-voltage characteristics and Josephson radiation have been studied for a number of indium bridges as a function of temperatures. These results show strong deviations from the predictions of the RSJ model, even in the temperature regime where the bridge size is smaller than the coherence length. This is ascribed to non-equilibrium effects in and around the microbridge. In order to improve the applicability of the Josephson effect, coherent arrays of 2, 4 and 10 microbridges were investigated. The 10 microbridge array is a novel design which allows the bridges to be parallel-biased at dc (equal voltages) and series-biased at 9 GHz (high output impedance).

33998 Study of the properties of coherent microbridges coupled by external shunts. Sandell, R.D.; Varmazis, C.; Jain, A.K.; Lukens, J.E. (State Univ. of New York, Stony Brook). *AIP Conf. Proc.;* No. 44, 327-334(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The coherent radiation emitted by two microbridges coupled by external shunt resistors was studied. Power spectra data and differential resistance measurements are presented. The relation between the observed linewidths and the differential resistances and considerations for the design of larger arrays are discussed.

33999 High-frequency properties of microbridge and point contact Josephson junctions. Skocpol, W.J. (Harvard Univ., Cambridge, MA). *AIP Conf. Proc.;* No. 44, 335-339(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Recent experiments by the Harvard Superconductivity Group concerning the response of variable-thickness microbridges to high harmonics of microwave radiation and the response of selected Nb point contacts to far-infrared laser radiation are reviewed. Gap structure on the dc I-V characteristics of the various devices can be used to recognize those junctions with the best high-frequency performance. Microbridges which show large numbers of microwave-induced steps to voltages as high as 4.2 mV have been studied, although their poor coupling and low impedance has not yet allowed the observation of steps induced by submillimeter radiation. Selected Nb point contacts which have better coupling and higher resistance have been used to study the steps induced by harmonics of 604 GHz (496 μm) laser radiation to as high as 12.5 mV, and by higher fundamental frequencies up to 2.52 THz (119 μm) at 5.2 mV. Such contacts have been used to measure the intrinsic rolloff of the ac Josephson effect beyond the superconducting energy gap frequency.

34000 Light-sensitive Josephson junctions: ten years ago, ten years from now. Barone, A. (Laboratorio di Cibernetica del CNR, Arco Felice, Italy); Russo, M.; Vaglio, R. *AIP Conf. Proc.;* No. 44, 340-344(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Recent developments of experimental investigations on light-sensitive junctions are discussed, also in connection to future applications.

34001 Millimeter wave response of Nb variable thickness bridges. Barr, D.W.; Mattauch, R.J.; Wang, L.K.; Deaver, B.S. Jr. (Univ. of Virginia, Charlottesville). *AIP Conf. Proc.;* No. 44, 345-348(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Niobium variable thickness bridges are being fabricated for testing as millimeter wave mixers. Bridges have been fabricated on fused quartz, silicon and gallium arsenide substrates and characterized by measurements of the I-V curve, and dV/dI versus V and by mixing experiments at 80 to 100 GHz. The bridges on Si and GaAs exhibit small Josephson steps but the response of all the bridges is limited by self-heating, and mixing appears to be primarily bolometric. However, the cooling of the bridges on Si is much better than the others.

34002 Properties of variable thickness bridges on GaAs substrates. Galfo, C.H.; Wang, L.K.; Deaver, B.S. Jr.; Barr, D.W.; Mattauch, R.J. (Univ. of Virginia, Charlottesville). *AIP Conf. Proc.;* No. 44, 349-353(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Structure on the I-V curves of Sn and Nb variable thickness bridges on GaAs substrates are being studied systematically both to characterize the junctions and to search for interactions of the Josephson oscillations with the substrate.

34003 Excess current in Nb and Nb_3Ga Josephson junctions. Nordman, J.E.; Houck, L.L. (Univ. of Wisconsin, Madison). *AIP Conf. Proc.;* No. 44, 354-358(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A simple density-of-states model is used to show that anomalous behavior observed in the volt-ampere characteristics of Nb_3Ga-Pb tunnel junctions is closely related to that observed in Nb-Pb and Nb-Nb junctions. This model, based on proximity effect considerations, provides an explanation for the following experimental observations: 1) A temperature-dependent negative resistance occurs at a voltage equal to the sum of the half-gaps in some Nb junctions but has not been observed for Nb_3Ga. 2) A current peak at the gap difference voltage is clearly evident only at high temperatures in these same Nb junctions. In Nb_3Ga junctions this peak persists to lower temperatures but its position shifts in the wrong direction, toward higher voltages. 3) The current rise near the gap sum voltage is very gradual in most Nb_3Ga junctions and does not correlate at all with the energy gap inferred from a T/sub c/ measurement.

34004 Superconductor-semiconductor device research. Silver, A.H.; Chase, A.B.; McColl, M.; Millea, M.F. (Aerospace Corp., El Segundo, CA). *AIP Conf. Proc.;* No. 44, 364-379(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Devices and components which combine both superconductors and semiconductors include Josephson and super-Schottky diodes, superconducting triodes, and hybrids. Semiconductors, such as Si, Ge, Te, GaAs, InAs, InSb, and CdS, are used to form barriers or effective barriers to electron and pair tunneling in the active regions of these devices. Hence such properties as bandgap, barrier height, and mobility become important parameters in tailoring and controlling the device performance. The motivation for this research, accomplishments to date, and an assessment of the future prospects are discussed.

34005 Josephson tunneling through Ge-Sn barriers. Hu, E.L.; Jackel, L.D.; Epworth, R.W. (Bell Lab., Holmdel, NJ). *AIP Conf. Proc.;* No. 44, 380-383(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Josephson tunneling has been observed through thick (—600A) barriers of coevaporated Ge-Sn mixtures. The barrier transparency can be adjusted by altering the ratio of the mixture components: for a given barrier thickness critical current densities have been varied over six orders of magnitude. In addition, the critical current density can be controlled by varying barrier thickness. For thick barriers, or barriers with low Sn content, high tunneling resistances and no supercurrent result. Barriers of intermediate thickness or moderate Sn content yield junctions with electrical properties very similar to conventional hysteretic oxide-barrier junctions. Thin or high Sn-content barriers give junctions with non-hysteretic I-V characteristics similar to those of a superconducting microbridge.

34006 Super-Schottky and Josephson-effect devices using niobium on thin silicon membranes. Roth, L.B.; Roth, J.A.; Schwartz, P.M. (Hughes Research Lab., Malibu, CA). *AIP Conf. Proc.;* No. 44, 384-388(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Super-Schottky and Josephson-effect devices have been fabricated using niobium on thin silicon membranes and their dc (I, V) characteristics have been measured. The rugged, reproducible Nb/Si super-Schottky devices exhibit at 1.9K a non-optimized sensitivity of $3800V^{-1}$ corresponding to a noise temperature of 3K. The transition from Giaever to Josephson tunneling is observed as the silicon barrier thickness is reduced.

34007 Improved materials for superconducting electronics. Beasley, M.R. (Stanford Univ., CA). *AIP Conf. Proc.;* No. 44, 389-396(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The potential advantages of hard and/or high transition temperature superconductors in superconducting electronics are discussed and recent progress in fabricating actual devices from these materials is reviewed.

34008 Granular superconductors for SQUIDs. Deutscher, G. (Tel Aviv Univ., Israel). *AIP Conf. Proc.;* No. 44, 397-403(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The low critical current density of granular superconductors makes them attractive for thin film SQUID applications. A survey of the properties of granular superconductors such as granular aluminium, lead and niobium is presented, and the actual performance of some granular SQUIDs is discussed. In addition to their convenient low critical current density, granular SQUIDs also appear to have low intrinsic noise levels.

34009 Surfaces of high-T/sub c/ Nb_3Ge films as studied by electron tunneling and auger electron spectroscopy. Buitrago, R.; Toth, L.E.; Goldman, A.M.; Dayan, M. (Univ. of Minnesota, Minneapolis). *AIP Conf. Proc.;* No. 44, 404-406(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Auger electron spectroscopy (AES) has been used to understand the nature of the surfaces of the top atomic layers of high-T/sub c/ sputter-deposited films of Nb_3Ge. Pb-Nb_3Ge tunneling junctions of high quality have been fabricated with oxidized thin aluminum barriers.

34010 Rf sputter anodisation of lead-indium films studied by ellipsometry. Donaldson, G.B. (Univ. of Strathclyde, Glasgow, Scotland); Faghihi-Nejad, H. *AIP Conf. Proc.;* No. 44, 407-411(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Simple ellipsometric equipment has been used to study the Rf sputter oxidation of a series of lead-indium alloy films containing from 0 to 46 atomic % In. The results show monotonic oxide growth for most films, with saturation thicknesses (3.0 to 9.0 nm) being reached within ~ 10 min for small In concentrations, and ~ 40 min for higher In concentrations. For films of 26 to 36 atomic % nominal In concentration, the oxide thickness rose to an intermediate maximum before decreasing to the equilibrium value. The In_2O_3 content

of the oxide layer was disproportionately large and, in particular, was 100% for all alloys containing more than 28 atomic % of indium.

34011 Cryocoolers for superconductive electronics. Zimmerman, J.E. (National Bureau of Standards, Boulder, CO). *AIP Conf. Proc.;* No. 44, 412-420(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Superconductive electronic devices are generally operated and will continue to be operated in liquid-helium cryostats. Appropriate small closed-cycle cryocoolers for these devices do not exist. Development of cryocoolers, including efficient use of conventional gas refrigeration cycles and innovative thoughts on new and unconventional methods, could greatly enhance the usefulness of small-scale superconductive electronics. Large cryocoolers are already well-developed and can be adapted to the requirements of large-scale systems, such as computers, requiring a watt or more of refrigeration.

34012 Design and construction of microminiature cryogenic refrigerators. Little, W.A. (RAI, Palo Alto, CA). *AIP Conf. Proc.;* No. 44, 421-424(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The small size and small refrigeration requirements of superconducting sensors make these devices a poor match to conventional cryogenic refrigeration systems. The design and construction problems of building microminiature refrigerators for the cooling of these devices which would match their cooling requirements are considered. Preliminary work is described on the construction of a first stage 77°K refrigerator built on a Si-wafer using photolithography.

34013 Digital Josephson technology: present and future. Welker, N.K.; Bedard, F.D. (Lab. for Physical Sciences, College Park, MD). *AIP Conf. Proc.;* No. 44, 425-436(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The current status of digital Josephson technology is presented, and some of the directions it will take in the future are indicated.

34014 SQUID digital electronics. Hurrell, J.P.; Silver, A.H. (Aerospace Corp., El Segundo, CA). *AIP Conf. Proc.;* No. 44, 437-447(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The use of SQUIDs enables the ultimate switching speeds and low power dissipation of Josephson devices to be achieved in digital logic systems. In addition, unique circuit capabilities become apparent which can simplify the logic circuits. These concepts will be applied to fast analog to digital conversion. A continuous signal is applied to a single-junction SQUID and converted to a pulse train of flux quanta. These quanta are counted in a scalar consisting of a linear array of coupled dc SQUIDs. Scaling is achieved by utilizing the bistable nature of a double-junction SQUID biased at the half-flux point. In this way fast, single-flux quantum logic can be achieved.

34015 Current-switched full adder fabricated by photolithographic techniques. Magerlein, J.H.; Dunkleberger, L.N.; Fulton, T.A. (Bell Lab., Murray Hill, NJ). *AIP Conf. Proc.;* No. 44, 459-464(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A one-bit full-adder based on Josephson tunnel junctions and fabricated by photolithographic techniques is described. The design employs current-switched gates with latching characteristics, direct-coupled control currents and parallel fanout. The linewidths are 25 μm. Simulated and indirectly measured delays/gate are approximately 100 psec.

34016 Memory device utilizing the storage of Abrikosov vortices at an array of pinning sites in a superconducting film. Hebard, A.F.; Fiory, A.T. (Bell Lab., Murray Hill, NJ). *AIP Conf. Proc.;* No. 44, 465-469(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

A nondestructive readout (NDRO) random access memory based on the use of a two-dimensional array of strong pinning sites in a film in the mixed state is proposed. Information is stored as the off-center displacement of vortices in overlay films. The overlay films are electrodes of a Josephson junction, which detects the position of the vortex by means of the critical current suppression.

34017 High-performance Josephson interferometer latching logic and power supplies. Herrell, D.J.; Arnett, P.C.; Klein, M. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). *AIP Conf. Proc.;* No. 44, 470-478(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Some recent measurements on high-performance Josephson latching logic are reviewed, and a compatible ac powering scheme which provides good voltage regulation and low clock skew performance for a large computing machine is discussed.

34018 Superconductive electronics in future computer designs. Zappe, H.H. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). *AIP Conf. Proc.;* No. 44, 479-482(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Recent work and trends in experimentally verified designs of Josephson logic and memory devices and circuits are discussed.

34019 Progress on millimeter wave Josephson junction mixers. Taur, Y.; Kerr, A.R. (Goddard Space Flight Center, New York, NY). *AIP Conf. Proc.;* No. 44, 254-258(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

Preset, recyclable Nb point contacts are tested as low-noise Josephson mixers at a signal frequency of 115 GHz. The best result achieved is a mixer noise temperature (single sideband) of 120 K with unity conversion efficiency (SSB) for a junction at 6 K. Variation of mixer properties with temperature and other parameters is presented.

34020 Fast superconducting instruments. Harris, R.E.; Hamilton C.A. (National Bureau of Standards, Boulder, CO). *AIP Conf. Proc.* No. 44, 448-458(1978). (CONF-780339—).

From Conference on future trends in superconductive electronics; Charlottesville, VA, USA (23 Mar 1978).

The emerging technology for fabricating superconducting integrated circuits offers the possibility of remarkable new instruments. The advantages of this form of electronics are high device speed and low dissipation, combined with lossless, dispersionless, properly terminated transmission lines. A number of possible new instruments are presented. It is shown that a small group can successfully fabricate the superconducting integrated circuits required for these new instruments.

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 34102

34021 (LA-UR—80-1617) Los Alamos Scientific Laboratory long-range alarm system. DesJardin, R.; Machanik, J. (Los Alamos Scientific Lab., NM (USA); Bradford National Corp., New York (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800913—2). NTIS, PC A02/MF A01.

From International conference: security through science and engineering; Berlin, F.R. Germany (23 Sep 1980).

The Los Alamos Scientific Laboratory (LASL) Long-Range Alarm System is described. The last few years have brought significant changes in the Department of Energy regulations for protection of classified documents and special nuclear material. These changes in regulations have forced a complete redesign of the LASL security alarm system. LASL covers many square miles of varying terrain and consists of separate technical areas connected by public roads and communications. A design study over a period of 2 years produced functional specifications for a distributed intelligence, expandable alarm system that will handle 30,000 alarm points from hundreds of data concentrators spread over a 250-km² area. Emphasis in the design was on nonstop operation, data security, data communication, and upward expandability to incorporate fire alarms and the computer-aided dispatching of security and fire vehicles. All aspects of the alarm system were to be fault tolerant from the central computer system down to but not including the individual data concentrators. Redundant communications lines travel over public domain from the alarmed area to the central alarm station.

34022 (UCRL—15137) Electrostatic fibrous air filters: a theoretical study. Final report. Banks, D.O.; Boyles, R.A. (California Univ., Davis (USA). Dept. of Mathematics). Sep 1979. Contract W-7405-ENG-48. 84p. NTIS, PC A05/MF A01.

A model of fibrous air filters is given which accounts for the inhomogeneity of the filter by assuming that the packing density and the fiber radius are random variables. Using the cell models of Happel and Kuwabara, a form of Darcy's Law for the pressure drop is derived in terms of appropriate averages of the local permeability. The resulting local mean velocity is then used to get formulas for the particle penetration through the filter. The influence of diffusion in the case of flow parallel to the filter fibers is investigated. Finally, a means of computing the single fiber efficiency in the case of externally electrified air filters is presented.

HANDLING EQUIPMENT AND PROCEDURES

34023 (UCRL—84318) Tritium practices past and present. Gede, V.P.; Gildea, P.D. (California Univ., Livermore (USA). Law-

rence Livermore National Lab.; Sandia National Labs., Livermore, CA (USA)). 1980. Contract W-7405-ENG-48. 8p. (CONF-800427—18). NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic applications; Dayton, OH, USA (29 Apr 1980).

History of the production and use of tritium, as well as handling techniques, are reviewed. Handling techniques first used at Lawrence Livermore National Laboratory made use of glass vacuum systems and relatively crude ion chambers for monitoring airborne activity. The first use of inert atmosphere glove boxes demonstrated that uptake through the skin could be a serious personnel exposure problem. Growing environmental concerns in the early 1970's resulted in the implementation by the Atomic Energy Commission of a new criteria to limit atmospheric tritium releases to levels as low as practicable. An important result of the new criteria was the development of containment and recovery systems to capture tritium rather than vent it to the atmosphere. The Sandia National Laboratories, Livermore, Tritium Research Laboratory containment and decontamination systems are presented as a typical example of this technology. The application of computers to control systems is expected to provide the greatest potential for change in future tritium handling practices.

TRANSPORT AND STORAGE FACILITIES

34024 Pipe-laying machine for oil pipelines, conduits and the like. Cecchi, C.; Bifani, A.G. (to Fiat-Allis Macchine Movimento Terra S.p.A.). US Patent 4,166,544. 4 Sep 1979. Priority date 7 Sep 1976, Italy, 6p.

A device for laying pipelines, conduits, etc. includes a pair of self-propelled vehicles joined by an intermediate bridge having a rigid lifting arm hinged at one end to the intermediate bridge and has a device for gripping and lifting the pipes carried by the free end of the rigid arm such that the rigid lifting arm may be controlled to engage a pipe and lift it over the trench and lower the pipe into the desired position.

MINING AND DRILLING EQUIPMENT AND FACILITIES

34025 Retrievable plug for offshore platforms. Streich, S.G. (to Halliburton Co.). US Patent 4,178,967. 18 Dec 1979. Filed date 14 Sep 1978. 12p.

A reusable plug for sealing the conductor pipe of offshore platforms comprising a cylindrical housing, central body member, pressure equalization means and retractable release means releasably securing the central body member to the cylindrical housing.

34026 Methods and apparatus for anchoring offshore pipeline. Nolan, C.E. Jr.; Tillinghast, W.S. (to Brown and Root, Inc.). US Patent 4,175,620. 27 Nov 1979. Filed date 6 Dec 1977. 14p.

An offshore pipeline installation comprises a wellhead base and a pipeline anchor connected together to form a unit which is lowered onto a seabed. The anchor is pivotably positionable relative to the wellhead base about a vertical axis of a pilot tube. A pin pile is inserted through the tube and into the seabed to isolate the pipeline anchor from the wellhead and wellhead base in relation to forces generated in anchoring a pipeline to the pipeline anchor. The anchor is selectively positionable for alignment with pipeline means to be laid, and may include a socket mounted for pivotal movement about one or more, axis. The socket is operable to receive pipeline means laid away from the anchor. The anchor may further include a ramp which is inclined relative to horizontal. The ramp is positionable generally laterally relative to the lay path of the pipeline means so that pipeline means laid upon the ramp gravitates downwardly toward clamp means at the foot of the ramp. 19 figures.

LASERS

REFER ALSO TO CITATION(S) 34262, 34426, 34427

34027 (AD-A—076492) **Investigation of the production of high density uniform plasmas. Volume I. Final report, 2 April 1978-2 April 1979.** Douglas-Hamilton, D.H.; Rostler, P. (Avco-Everett Research Lab., Everett, MA (USA)). May 1979. Contract F33615-78-C-2013. 56p. NTIS, PC A04/MF A01.

The discharge streamer instability, which leads to arcing in non self-sustaining discharges is investigated experimentally and theoretically. Framing camera studies of streamer growth from the cathode of an e-beam sustained discharge in various gases under various discharge conditions are discribed, analyzed, and compared with theoretical predictions. A previously developed model of the streamer is extended to include a more detailed description of the density, temperature, and input power distributions around the streamer tip. Stable high-density plasma discharges have many applications in plasma physics. An especially significant example is the use of these discharges in high-power gas lasers. The work described here concerns investigation of the external ionization e-beam sustainer method of producing a high-density discharge, together with the advantages and instabilities peculiar to that system.

34028 (AD-A—076507) **Study of lasers. Final report, 15 July 1976-14 July 1979.** Sorokin, P.P. (IBM Watson Research Center, Yorktown Heights, NY (USA)). 15 Oct 1979. Contract DAAG29-76-C-0062. 10p. NTIS, PC A02/MF A01.

Results achieved in four separate laser studies are summarized. Topics covered are (a) time-resolved infrared spectral photography, (b) laser-included thermal explosions, (c) parahydrogen 16 micron tunable source, and (d) a study of the c (triplet) pi (u) state of H2 in discharges.

34029 (AD-A—077040) **Investigation of surface-stabilized high-pressure gas discharges. Final report, 22 May 1978-21 May 1979.** Christensen, C.P. (University of Southern California, Los Angeles (USA)). 20 Jun 1979. Contract N00173-78-C-0440. 24p. NTIS, PC A02/MF A01.

The research program described herein is an experimental investigation of problems associated with the production of stable, long-duration discharges in rare gas halogen mixtures. The work is oriented toward homogeneous, high-level excitation of small gas volumes (about 1 cu cm) with the ultimate goal being construction of a discharge-pumped rare gas halide laser which is capable of an output pulse duration greater than one microsecond.

34030 (AD-A—077153) **Electrooptical devices. Semiannual technical summary report, 1 October 1978-31 March 1979.** Hurwitz, C.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Mar 1979. Contract F19628-78-C-0002. 20p. NTIS, PC A02/MF A01.

This report covers work carried out with support of the Department of the Air Force during the period 1 October 1978 through 31 March 1979. The current objectives of the electrooptical device program are: (1) to perform life tests on GaInAsP/InP double-heterostructure (DH) diode lasers operating in the 1.0- to 1.3-micrometer wavelength region and analyze the degradation mechanisms, and (2) to fabricate and study avalanche photodiodes of similar composition GaInAsP operating in the same wavelength region.

34031 (CONF-790355—) **Second international conference on infrared physics.** Affolter, E.; Kneubuehl, F. (eds.). (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1979. 460p. NTIS (US Sales Only), PC A20/MF A01.

From 2. international conference on infrared physics; Zurich, Switzerland (5 Mar 1979).

Includes supplement and NASA programs in infrared astronomy.

Twenty-one invited papers and nearly 100 contributed papers were presented at this conference on such topics as laser physics, ir detection, spectroscopy, solid state physics, astrophysics, atmospheric physics, and applications of ir lasers in chemistry, medicine, and car manufacture. Two of the papers given at the conference have already been entered into the TIC data base; these papers can be located by means of the entry CONF-790355—. (RWR)

34032 (SAND—80-0261) **Phoenix I energy extraction experiment.** Hoffman, J.M.; Patterson, E.L.; Tisone, G.C.; Moreno, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01.

Energy extraction experiments are reported for the Phoenix I amplifier driven by a discharge-initiated oscillator-preamplifier system operating on mixtures of either SF_6-HI or SF_6-C_2H_6 and an electron-beam-initiated intermediate amplifer (A-3) fueled with H_2 and F_2 mixtures. When the oscillator-preamplifier system operated with mixtures of SF_6-HI the input spectrum to the Phoenix I amplifier contained ~ 28 P-branch vibrational-rotational lines which were almost identical to the input spectrum from the H_2-F_2 fueled oscillator. In this case the energy extraction measurements were essentially the same as the results obtained with the spectrum produced using H_2 and F_2 mixtures. For an input intensity of 10^7 W/cm^2, 170 J were extracted from the amplifier. With the SF_6-C_2H_6 spectrum, extraction was only obtained from the first three excited vibrational levels. This result indicates that most of the energy in the amplifier could be extracted on the first three excited vibrational levels. It is shown that the extraction results can be fit with a simple two level model. The radius of curvature of the beam was estimated using a lateral shearing interferometer. It was found that the Phoenix I amplifier altered the radius of curvature.

HEAT TRANSFER AND FLUID FLOW

34033 (EPRI-CS—1456) **Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978.** Staub, F.W. (General Electric Co., Schenectady, NY (USA). Power Gen-

eration and Propulsion Lab.). Jul 1980. 323p. NTIS, PC A14/MF A01.

Cold modeling studies of fluidized-bed behavior related to coal combustion were conducted to provide information required for the design and optimization of fluidized-bed systems for power generation. Data for flow regime, bed expansion (void fraction), transverse thermal conductivity, and bare- and finned-tube heat transfer were obtained for beds of single and mixed particle sizes fluidized with air and refrigerant R-12 at room temperature. The ranges of primary variables covered in the experimental work reported here include bed cross sections of 0.3 meter by 0.3 meter and 0.6 meter by 0.6 meter, static bed heights from 25 cm to 70 cm, glass particle sizes of 650 μm and 2600 μm, and silica sand sizes in the same range, air at pressures from one to ten atmospheres and refrigerant R-12 at vapor densities equal to those of air at five and ten atmospheres, air velocities up to 6.5 m/s and 3.2 m/s at one and ten atmospheres pressure, respectively. The staggered horizontal tube banks investigated in the flow and heat transfer experiments included 3.2-cm o.d. bare tubes and 2.5-cm i.d. helically finned tubes having a 5.1-cm fin o.d. The stainless steel fins were 0.27 cm and 0.15 cm thick at fin spacings of 0.98 fin/cm to 1.97 fins/cm, respectively. Five- and ten-row tube banks were tested. Generalized predictive models for the bed flow regimes, the bed expansion, the solids circulation rates, and the heat transfer to tube banks were developed and shown to be qualified by the data for both local and average bed quantities. The information and observations described here lend sufficient support to the use of higher energy density fluidized-bed combustors at increased superficial gas velocities to justify further work at high temperature aimed at validating this performance improvement.

34034 (UCRL—84655) **Numerical analysis of laminar forced convection in a spherical annulus.** Tuft, D.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jul 1980. Contract W-7405-ENG-48. 43p. (CONF-801027—1). NTIS, PC A03/MF A01.

From 4. biennial cube symposium; Livermore, CA, USA (22 Oct 1980).

Calculations of steady laminar incompressible fluid-flow and heat transfer in a spherical annulus are presented. Steady pressures, temperatures, velocities, and heat transfer coefficients are calculated for an insulated outer sphere and a 0°C isothermal inner sphere with 50°C heated water flowing in the annulus. The inner sphere radius is 13.97 cm, the outer sphere radius is 16.83 cm and the radius ratio is 1.2. The transient axisymmetric equations of heat, mass, and momentum conservation are solved numerically in spherical coordinates. The transient solution is carried out in time until steady state is achieved. A variable mesh is used to improve resolution near the inner sphere where temperature and velocity gradients are steep. It is believed that this is the first fully two-dimensional analysis of forced flow in a spherical annulus. Local and bulk Nusselt numbers are presented for Reynolds numbers from 4.4 to 440. Computed bulk Nusselt numbers ranged from 2 to 50 and are compared to experimental results from the literature. Inlet flow jetting off the inner sphere and flow separation are predicted by the analysis. The location of wall jet separation was found to be a function of Reynolds number, indicating the location of separation depends upon the ratio of inertia to viscous forces. Wall jet separation has a pronounced effect on the distribution of local heat flux. The area between inlet and separation was found to be the most significant area for heat transfer. Radial distributions of azimuthal velocity and temperature are presented for various angles beginning at the inlet. Inner sphere pressure distribution is presented and the effect on flow separation is discussed.

34035 Unit thermal performance of atmospheric spray cooling systems. Porter, R.W.; Jain, M.; Chaturvedi, S.K. (Illinois Institute of Technology, Chicago, Illinois). EC-77-S-02-4531. *J. Heat Transfer;* **102**: No. 2, 210-214(May 1980).

Thermal performance of an open atmospheric spray pond or canal depends on the direct-contact evaporative cooling of an individual spray unit (spray nozzle or module) and the interference caused by local heating and humidification. Droplet parameters may be combined into a dimensionless group, number of transfer units (NTU) or equivalent, whereas large-scale air-vapor dynamics determine interference through the local wet-bulb temperature. Quantity NTU were implied from field experiments for a floating module used in steam-condenser spray canals. Previous data were available for a fixed-pipe nozzle assembly used in spray ponds. Quantity NTU were also predicted using the Ranz-Marshall correlations with the Sauter-mean diameter used as the characteristic length. Good agreement with experiments was shown for diameters of 1--1.1 cm (module) and 1.9 mm (fixed-pipe nozzle).

34036 Steady thermal convection from a concentrated source in a porous medium. Hickox, C.E.; Watts, H.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-ACOY-76DP00789. *J. Heat Transfer;* **102**: No. 2, 248-253(May 1980).

Solutions for the steady, axisymmetric velocity and temperature fields associated with a point source of thermal energy in a fluid-saturated porous medium are obtained numerically through use of similarity transformations. The two cases considered are those of a point source located on the lower, insulated boundary of a semi-infinite region and a point source embedded in an infinite region. Numerical results are presented from which complete descriptions of the velocity and temperature fields can be constructed for Rayleigh numbers of 0.1, 1.0, 10.0, and 100.0

34037 Combined radiation convection in thermally developing Poiseuille flow with scattering. Chawla, T.C.; Chan, S.H. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Heat Transfer;* **102**: No. 2, 297-302(May 1980).

The solution for thermally developing Poiseuille flow with scattering is obtained by using the method of collocation. The results show that scattering tends to decrease radiation component without affecting the convective component at low optical thicknesses. For moderate to high values of optical thicknesses, both the convective and radiation components are reduced. The relative effect of scattering both on convective and radiation Nusselt numbers appears to be unaffected by a change in the surface emissivity. A significant feature of combined radiation-convection in thermally developing flows appears to be that the total Nusselt number increases downstream of position of minimum rather than approaching an asymptotic value as is the case with corresponding pure convection. Another departure in the behavior appears to be the lack of existence of similarity in the temperature profiles, particularly at low values of conduction-radiation parameter.

34038 Transient solidification in flow into a rod bundle. Epstein, M.; Stachyra, L.J.; Lambert, G.A. (Reactor Analysis and Safety Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *J. Heat Transfer;* **102**: No. 2, 330-334(May 1980).

Transient solidification of a liquid in axial flow into and through a cold rod bundle was investigated. Experiments are described in which the amount of liquid displaced through the rod bundle before freezing shut as a function of pressure drop was measured. Simple relations for the liquid mass displaced into or through the rod bundle were derived by combining the notion of a time-dependent hydraulic diameter with an available approximate method for treating transient solidification in a tube flow. The relations are shown to be approximately consistent with the experimental data.

34039 Experimental study of falling liquid film breakdown on a horizontal cylinder during heat transfer. Ganic, E.N.; Roppo, M.N. (Department of Energy Engineering, University of Illinois at Chicago Circle, Chicago, Illinois 60680). *J. Heat Transfer;* **102**: No. 2, 342-346(May 1980).

In this study, an experimental investigation was conducted with subcooled water film flowing over an electrically heated horizontal cylinder. The combinations of film flow rate and heat flux at which film breakdown occurs (i.e., dry patches appear on the surface) were determined. At the conditions prior to dry patch formation, the heat transfer coefficient was determined as well. The results showed that the heat flux needed to cause a dry patch increases with film flow rate. Also, prior to dry patch formation, the heat transfer coefficient increases with film flow rate. The effects of the tube spacing and the liquid film inlet temperature on the breakdown heat flux and heat transfer coefficient were also studied.

34040 Boundary layer behavior in transient turbulent thermal convection flow. Cheung, F.B. (Reactor Analysis and Safety Division, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, Illinois 60439). *J. Heat Transfer;* **102**: No. 2, 373-375(May 1980).

It is shown that in heat source-driven turbulent convection, the transient behavior of the thermal boundary layer is markedly different from that of the steady-state condition.(AIP)

34041 Parametric analysis of the performance of internally finned tubes for heat exchanger application. Webb, R.L.; Scott, M.J. (Department of Mechanical Engineering, The Pennsylvania State University, University Park, Pennsylvania 16802). EG-78-S-02-4649. *J. Heat Transfer;* **102**: No. 1, 38-43(Feb 1980).

This paper presents a parametric analysis of the performance of internally finned tubes in turbulent forced convection for application to heat exchangers. The analysis compares the performance of an internally finned tube exchanger with that of an exchanger having internally smooth tubes. The calculations are performed for three important design cases.

34042 Free convection heat transfer across rectangular-celled diathermanous honeycombs. Smart, D.R.; Hollands, K.G.T.; Raithby, G.D. (Diesel Division, General Motors of Canada, Ltd. London, Ontario, Canada). EY-76-C-02-2597. *J. Heat Transfer;* **102**: No. 1, 75-80(Feb 1980).

Experimental obtained Nusselt number-Rayleigh number plots are presented for free convective heat transfer across inclined honeycomb panels filled with air. The honeycomb cells were rectan-

gular in shape with very long cell dimensions across the slope and comparatively short dimensions up the slope. Elevation aspect ratios, A/sub E/, investigated were 3, 5 and 10; angles of inclination, θ, measured from the horizontal, were 0, 30, 60, 75 and 90 deg. The effect on the Nusselt number, of the emissivities of the plates bounding the honeycomb, and of the emissivity of honeycomb material, was also investigated. The measurements confirmed that the critical Rayleigh number and the post-critical heat transfer depend on the radiant properties of the honeycomb cells. The critical Rayleigh numbers at $\theta=0$ were well predicted by the methods of Sun and Edwards. For $0<\theta<$ or $=75$ deg, the critical Rayleigh numbers and the Nusselt-Rayleigh relations were both found to be essentially the same as their horizontal counterparts provided the Rayleigh number was first scaled by cos θ. For $\theta=90$ deg, the form of the Nusselt-Rayleigh relation was found to be very different from that for $\theta<$ or $=75$ deg and similar to that observed for square-celled honeycombs for $\theta>30$ deg. The $\theta=90$ deg data were found to be closely correlated by an equation of the form recently proposed by Bejan and Tien.

34043 Combined natural convection and radiation in a volumetrically heated fluid layer. Chawla, T.C.; Chan, S.H.; Cheung, F.B.; Cho, D.H. (Reactor Analysis and Safety Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Heat Transfer;* **102**: No. 1, 81-85(Feb 1980).

The effect of radiation in combining with turbulent natural convection on the rates of heat transfer in volumetrically heated fluid layers characterized by high temperatures has been considered in this study. It is demonstrated that even at high Rayleigh numbers the radiation mode is as effective as the turbulent natural convection mode in removing the heat from the upper surface of molten pools with adiabatic lower boundary. As a result of this improved heat transfer, it is shown that considerably thicker molten pools with internal heat generation can be supported without boiling inception. The total Nusselt number at a moderate but fixed value of conduction-radiation parameter, can be represented as a function of Rayleigh number in a simple power-law form. As a consequence of this relationship it is shown that maximum nonboiling pool thicknesses vary approximately inversely as the 0.9 power of internal heat generation rate. A comparison between exact analysis using the integral formulation of radiation flux and Rosseland approximateion shows that the latter approximation bears out very adequately for optically thick pools with conduction-radiation parameter $>$ or $\approx$0.4 inspite of the fact that individual components of Nusselt number due to radiation and convection, respectively, are grossly in error. These errors in component heat fluxes are compensating due to the total heat balance constraint. However, the comparison between Rosseland approximation and exact formulation gets poorer as the value of conduction-radiation parameter decreases. This increase in error is principally incurred due to the error in estimating wall temperature differences.

34044 Monte Carlo method of solving heat conduction problems. Fraley, S.K.; Hoffman, T.J.; Stevens, P.N. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *J. Heat Transfer;* **102**: No. 1, 121-125(Feb 1980).

A new approach in the use of Monte Carlo to solve heat conduction problems is developed using a transport equation approximation to the heat conduction equation. A variety of problems is analyzed with this method and their solutions are compared to those obtained with analytical technique. This Monte Carlo approach appears to be limited to the calculation of temperatures at specific points rather than temperature distributions. The method is applicable to the solution of multimedia problems with no inherent limitations as to the goemetric complexity of the problem.

MATERIALS TESTING

34045 (IS-T—900) Crack depth determination by ultrasonic frequency analysis aided by dynamic photoelasticity. Singh, A. (Ames Lab., IA (USA)). Aug 1980. Contract W-7405-ENG-82. 117p. NTIS, PC A06/MF A01.

Thesis.

A non-destructive method for characterizing the depth of artificial surface-breaking flaws (slots) using Rayleigh surface waves is described. Dynamic photoelasticity was used to obtain a full-field visualization of the waves generated on interaction of a Rayleigh wave with a slot. This visualization showed that for slot lengths of the same order of size as the predominant wavelengths in the incident Rayleigh wave, there is a significant interaction of the subsurface Rayleigh disturbance with the slot tip, producing transmitted surface disturbances that were quantitatively analyzed. Specifically, the frequency content of these transmitted waves was found for four different slot depths. The high frequency components of these transmitted signals exhibited a maximum frequency which decreased with increasing slot depth. This was attributed to the fact that the maximum frequencies of the subsurface field of the incident Rayleigh wave decrease with increasing depth. Ultrasonic testing was also done on surface slots in steel blocks, using commercial Rayleigh wave transducers. A relationship similar to the photoelastic results was obtained for the frequency components of the transmitted waves at the surface relative to the slot depth. However, in the ultrasonic case, there was a definite high frequency cut off point which could be directly related to the slot depth for slots perpendicular to the surface. This relationship was shown to also accurately predict the depth of inclined slots.

34046 (LA-UR—80-2039) Application of MOOT to scattering of elastic waves from compound inclusions. Visscher, W.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800767—2). NTIS, PC A02/MF A01.

From DARPA/AFML review of progress in quantitative NDE conference; La Jolla, CA, USA (14 Jul 1980).

It is shown how MOOT (method of optimal truncation, a convergent T-matrix scheme) can be used to calculate elastic wave scattering from compound inclusions, i.e., inclusions which themselves contain flaws - inclusions, voids, or cracks. The general equations are derived, and they are solved for a particular axially-symmetric case - a cracked spherical inclusion immersed in fluid. The crack edge is a circle on the equatorial plane; the crack can extend either inward to the center or outward to the surface of the sphere. Numerical results are given for scattering of acoustic waves from cracked spheres of various materials. Cracked spheres can be fabricated relatively easily, and may be useful in NDE calibrations.

34047 (LA-UR—80-2040) Generalized ultrasonic system for microcomputer controlled data collection. Strong, R.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800767—1). NTIS, PC A02/MF A01.

From DARPA/AFML review of progress in quantitative NDE conference; La Jolla, CA, USA (14 Jul 1980).

A system developed by the NDE Group of the Los Alamos Scientific Laboratory for the automated scanning of objects with an axis of rotation is described. This system is still being expanded to allow greater versatility in the motions. Data which was collected using the system and some typical test objects are also presented and discussed.

34048 (SAND—80-8733) Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology. Thomas, G.H. (Sandia Labs., Livermore, CA (USA)). Jul 1980. Contract AC04-76DP00789. 26p. (CONF-801021—2). NTIS, PC A03/MF A01.

From ASNT fall conference; Houston, TX, USA (6 Oct 1980).

Unquestionably, the mose important component of an ultrasonic inspection system is the transducer. Without the proper transducer, chances of a successful ultrasonic inspection are slim. The role of the transducer has become even more important with the advent of computerized ultrasonic techniques. Applying advanced ultrasonic inspection technology, such as signal processing and pattern recognition, necessitates the determination of various, critical transducer parameters. A transducer characterization facility, that consists of an ultrasonic pulser/receiver, an oscilloscope, a spectrum analyzer and a Schlieren imaging system, is described and sample transducer characterizations are presented.

34049 (UCRL—52975) Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing. Sears, F.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1980. Contract W-7405-ENG-48. 369p. NTIS, PC A16/MF A01.

Thesis.

The attenuation of energy and the change in shape of transient waveforms is a basic feature associated with the propagation of waves in crustal rocks. The dimensionless quality factor Q is observed as a useful quantity to characterize the attenuation of energy. Existing an elastic (attenuation) theories on the Q-determination problem are compared with experimental measurements to better understand rock properties. Experimental attenuation measurements were made on Avery Island (Louisiana) rock salt, Westerly (Rhode Island) granite, and Creighton (Ontario) quartz biotite gabbro. The attenuation mechanisms and how they affect the agreement between the an elastic theories were examined. Ultrasonic pulse methods were utilized of examine crack geometries as a function of frequency and thermal cycling temperature in dry polycrystalline rock salt. The attenuation of compressional (P) and shear (S) waves was studied in a thermally-induced, isotropic distribution of microcracks using ultrasonic-transmission techniques. These attenuation measurements led to the following series of generalities: ultrasonic or seismic attenuation depends on frequency in the rocks tested; thermal cycling of rock salt increases the porosity and attenuation; grain scattering seems to be the dominant loss mechanism at the higher frequencies in rocks; friction explains why the introduction of cracks into rock salt increases the attenuation; and attenuation appears to be independent of strain amplitude for low strains (10^{-6}) such as those associated with these measurements. Much work remains to be done

to adequately describe the attenuation loss mechanisms and the an elasticity of rocks both experimentally and theoretically.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 33444

34050 (BDX—613-2392) **Cure cycle evaluation for multilayer printed wiring boards.** Lula, J.W. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 16p. NTIS, PC A02/MF A01.

The cure cycle for multilayer printed wiring boards (PWBs) made from general-puspore, fire-retardant epoxy/glass (GF) material has been evaluated for the optimum delamination resistance at soldering temperatures. The results that, for the epoxy resin system used to manufacture multilayer PWBs at Bendix Kansas City, a wide range of cure cycle variations has a minimal effect on delamination resistance.

34051 (BDX—613-2458) **Plasma etchback of multilayer printed wiring boards.** Gentry, F.L. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 17p. NITS, PC A02/MF A01.

Removal of epoxy smear and glass fiber protrusions in multilayer printed wiring board holes was investigated. Gas plasma techniques, using a mixture of carbon tetrafluoride and oxygen, removed the eposies; however, the glass fibers were not affected.

34052 (BDX—613-2466) **Semiconductor chip processing. Final report.** Grimm, A.V. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 10p. NTIS, PC A02/MF A01.

The processes necessary to assemble metal-oxide semiconductor devices in hermetic ceramic packages were developed. The assembly techniques developed were gold-silicon die attachment, 25.4-μm aluminum wire interconnection, and gold-tin cover attachment.

34053 (BDX—613-2478) **Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication.** Thomas, N.C.; Zawicki, L.R. (Bendix Corp., Kansas City, MO (USA)). Aug 1980. Contract AC04-76DP00613. 23p. (CONF-801024—2). NTIS, PC A02/MF A01.

From ISHM annual meeting; New York, NY, USA (20 Oct 1980).

Improved testing techniques for monitoring thin film product characteristics and process control were developed primarily to provide a real-time, full-process monitor to test thin film adhesion and to evaluate thin film properties under accelerated aging. Additionally, more cost-effective methods were developed to monitor process control through measurement of film properties that relate directly to key process variables. A special circuit pattern was designed to offer improved information-gathering capabilities. This pattern is now included on the corner of production substrates to monitor thin film adhesion, via resistance, and resistor film temperature coefficient of resistance (TCR), and life stability. Minicomputer hardware and software were developed to monitor thin film interface resistance changes under accelerated aging conditions of elevated temperature, high humidity, and corrosive environments. Curves for different aging characteristics were developed for different thin film metallization systems and for some process and substrate variables. Interface aging characteristics were compared with lead frame bond pull-test data.

34054 **Differentially-charged and sequentially-switched square-wave pulse forming network.** North, G.G.; Vogilin, G.E. (to Dept. of Energy). US Patent 4,196,359. 1 Apr 1980. Filed date 8 Jun 1978. 6p. PAT-APPL-913,634.

A pulse forming network for delivering a high-energy square-wave pulse to a load, including a series of inductive-capacitive sections wherein the capacitors are differentially charged higher further from the load. Each charged capacitor is isolated from adjacent sections and the load by means of a normally open switch at the output of each section. The switch between the load and the closest section to the load is closed to begin discharge of the capacitor in that section into the load. During discharge of each capacitor, the voltage thereacross falls to a predetermined potential with respect to the potential across the capacitor in the next adjacent section further from the load. When this potential is reached, it is used to close the switch in the adjacent section further from the load and thereby apply the charge in that section to the load through the adjacent section toward the load. Each successive section further from the load is sequentially switched in this manner to continuously and evenly supply energy to the load over the period of the pulse, with the differentially charged capacitors providing higher potentials away from the load to compensate for the voltage drop across the resistance of each inductor. This arrangement is low in cost and yet provides a high-energy pulse in an acceptable square-wave form.

34055 (SAND—78-1065) **Admittance of an infinitely long monopole antenna driven by a coaxial line.** Morris, M.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01.

Experiments with monopole antennas are often performed with only one or several drive geometries because of time and expense limitations. In order to correlate admittance measurements made with one drive geometry to those made with other drive geometries, end corrections are necessary. In this paper, the admittance of a coaxially-driven infinite monopole over an infinite ground plane is accurately calculated for a wide range of parameters. Differences of these admittances can be added or subtracted to correct for drive geometry changes in finite antennas that are not too short.

34056 (SAND—79-0688) **Microcomputer closed circuit television controller.** Kinsey, C.H.; Maschoff, L.W. (Sandia Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01.

A controller has been developed for the Perimeter Surveillance System Closed Circuit Television for the Base and Installation Security System Program Office. Its prime function is to decode perimeter sensor alarm data and alert the operator so he can assess it over closed circuit television. It also warns the operator of link failures and provides a surveillance feature that sequentially displays all on-line camera data. A minimum configuration includes 160 sensors, 10 sensor sectors, 20 cameras, and 5 display monitors. It utilizes an F8 microcomputer requiring 4Kb of PROM and 1Kb of RAM. Two identical controllers will double capability. A four-wire communications bus and an interrupt capability maintain system integrity.

34057 (SAND—79-1490) **Admittance of an infinitely long monopole antenna immersed in a dissipative medium and driven by a coaxial line with a nondissipative dielectric bead in the end.** Morris, M.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01.

When monopole antennas are used to probe liquids, solids, or gases, it is necessary to place a solid boundary at the end of the coaxial line feeding the antenna or the medium being probed will enter the line and will adversely affect the measurement. An experimental technique often used to correct this situation is to place an electrically thin nondissipative dielectric bead in the end of the coaxial line. The effect of this bead on the admittance of the monopole antenna is quantified accurately in this paper by numerically solving the coupled pair of singular integral equations that result from formulating the corresponding infinite antenna problem as a rigorous boundary value problem. The findings based on the calculations are: (1) even very thin beads can affect measurement of admittances significantly in experimentally realizable situations; (2) the correction to the admittances is capacitive (imaginary and proportional to frequency) for thin beads; (3) the capacitive correction term is proportional to the thickness of the bead if the outer diameter of the bead is the same diameter as the air-filled coaxial line; and (4) matching the characteristic impedance of the air-filled portion of the coaxial line to that of the dielectric bead portion of the line is not particularly helpful in the interpretation of experimental data.

34058 (SAND—80-0420C) **Delay modeling in logic simulation.** Acken, J.M.; Goldstein, L.H. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 9p. (CONF-801005—1). NTIS, PC A02/MF A01.

From International conference on circuits and computers; Port Chester, NY, USA (1 Oct 1980).

As digital integrated circuit size and complexity increases, the need for accurate and efficient computer simulation increases. Logic simulators such as SALOGS (SAndia LOGic Simulator), which utilize transition states in addition to the normal stable states, provide more accurate analysis than is possible with traditional logic simulators. Furthermore, the computational complexity of this analysis is far lower than that of circuit simulation such as SPICE. An eight-value logic simulation environment allows the use of accurate delay models that incorporate both element response and transition times. Thus, timing simulation with an accuracy approaching that of circuit simulation can be accomplished with an efficiency comparable to that of logic simulation. 4 figures.

34059 (SLAC-PUB—2480) **RF Energy Compressor.** Farkas, Z.D. (Stanford Linear Accelerator Center, CA (USA)). Feb 1980. Contract AC03-76SF00515. 4p. (CONF-8005100—1). NTIS, PC A02/MF A01.

From International microwave symposium; Washington, DC, USA (28 May 1980).

The RF Energy Compressor, REC described here, transforms cw rf into periodic pulses using an energy storage cavity, ESC, whose charging is controlled by 180° bi-phase modulation, PSK, and external Q switching, βs. Compression efficiency, C/sub e/, of 100% can be approached at any compression factor C/sub f/.

34060 Schottky barrier formation by laser irradiation processing. Yang, E.S.; Wu, C.M.; Vollmer, H.J.; Sedgewick, T.O.; Hodgson, R.T. (Columbia University, New York, New York 10027). ET-78-R-03-1876. *Appl. Phys. Lett.;* **37**: No. 5, 462-463(1 Sep 1980).

A Schottky barrier is fabricated with a silicon-aluminum-silicon structure by the irradiation of either a pulsed or cw laser. The completed diodes have a large barrier height (1 eV) and good rectifying properties.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 33815

34061 Causes and alleviation of explosions in solid waste shredders. Nollet, A.R.; Sherwin, E.T. New Castle, DE; AENCO, Incorporated (1979). 15p. (CONF-7908124—1).

From 17. annual international seminar and equipment show; San Diego, CA, USA (27 Aug 1979).

Portions of document are illegible.

US Household Waste contains a number of items which if shredded will almost certainly result in explosions. There are three general classes of such items - self-oxidants, explosive vaporized liquids, and dust. Self-oxidants include cans of smokeless powder, sticks of dynamite, military ordnance and, very possibly, high nitrogen fertilizers mixed with oil. Explosive vaporized liquids include gasoline, paint thinner and aerosol cans pressurized with hydrocarbons. Explosive dusts include flour, coal and similar carbon-bearing dusts. Explosions of self-oxidants cannot be prevented or suppressed. Their effects can be alleviated somewhat by installing extra-strong shredders, conveyors and hoppers - and by providing adequate vents sufficiently strong to contain the shock forces generated. Such vents must be designed to contain high-speed ballistic objects projected from the hammers in the mill - while still allowing explosive gases to escape. Explosions caused by explosive vapor or dust mixtures may be alleviated by water fog suspended in the shredder enclosure and in other processing enclosures. Some such explosions may be stopped by the use of pressurized anti-explosion chemical systems - but much explosive vapor may remain after such systems extinguish the primary explosion. This may result in explosions in other contiguous unprotected processing equipment. Extensive venting is needed to alleviate such explosions. Gentle mechanical sorting to remove explosives is far preferable to shredding as the first step in processing solid waste. AENCO, Inc. will never again design or construct a resource recovery plant that shreds as the first processing step.

34062 Energy Recovery from Waste and Biomass Project. Brown; Caldwell. Rosemead, CA; Southern California Edison Co. (1979). 33p. (NP—25102).

The energy-recovery facility proposed for construction at the City of Santa Monica's refuse transfer station is planned to demonstrate technology for recovery of medium-Btu gas, steam, and ferrous metal from solid wastes. It is an element of Southern California Edison's research and development effort on alternative energy sources. SCE's Energy Recovery from Waste and Biomass Program consists of 9 phased projects directed toward commercial production of methane from refuse by 1987. The demonstration project is expected to be operational by July, 1981, with the capacity to process up to 200 tons per day through the energy-recovery facility. The front-end, refuse-processing plant will have a capacity of 20 tons per hour. The City can expect to use the plant throughout its useful life to reduce by about 50% the quantity of refuse it must haul to landfills.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 33238, 33815, 34033

34063 (EPRI-CS—1469) **Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments.** McCarron, R.L.; Grey, D.A. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Aug 1980. 183p. NTIS, PC A09/MF A01.

This report condenses into a single document the available information related to the performance of gas turbine materials operated in the effluent from the combustion of coal. The information summarized originated from three sources: work performed in the period 1940-1970 to establish the potential for a direct coal-fired gas turbine, actual operating experience of gas turbines in particulate-laden environments, and recent efforts to evaluate gas turbines for firing with a pressurized fluidized-bed combustor. Results of these studies show clearly that the potential for erosion, corrosion, and deposition exists in gas turbines operated on coal to the extent that the performance and endurance may be substantially reduced. The choice of gas turbine materials strongly influenced the lifetimes of components exposed to coal-derived environments. Bare alloys, such as IN-738, U-700, and X-40, exposed to the hot gas path degraded more rapidly than MCrAlY coatings or claddings which produce protective layers of alumina or chromia. Extremely hard coatings containing high concentration of carbides in a ductile matrix were particularly resistant to erosion. The interaction between corrosion and erosion appears to be synergistic; however, the exact relationships between these processes are still unknown.

34064 (EPRI-CS—1475) **Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report.** Minchener, A.J.; Rogers, E.A.; LaNauze, R.D. (National Coal Board, Stoke Orchard (UK). Coal Research Establishment). Aug 1980. 185p. NTIS, PC A09/MF A01.

The influence of operating conditions in a coal fired fluidized bed combustor on the rate of fireside corrosion of air cooled heat exchanger tubes, with metal temperatures in the range 540°C to 900°C, has been investigated. Four 250 hour tests were carried out on a 0.3 m square atmospheric pressure fluidized bed combustor operating with a fluidizing velocity of 0.9 ms^{-1}, 10 to 20% excess air and bed temperatures of 850°C and 900°C. The feed coal was Illinois No. 6 which was used both with and without the addition of limestones to suppress the emission of sulfur oxides. A test without the addition of limestone showed very little corrosive attack of any metal components. Tests with the addition of limestone showed a range of corrosive attack. In general, where different alloy types were exposed at the same metal temperature, the iron based austenitic steels showed a better corrosion resistance than the nickel based alloys. This result strongly supports the model for the corrosion which has been developed as a result of the earlier investigations. This model postulates that local regions of low oxygen activity exist in the system, and, in the presence of calcium sulfate, these result in the generation of high local sulfur activities. The combination of low oxygen and high sulfur activities leads to sulfidation of sensitive alloys.

34065 (FE—2471-45) **Industrial application fluidized bed combustion. Category III: indirect fired heaters. Quarterly technical report No. 14, October 1-December 31, 1979.** (Exxon Research and Engineering Co., Florham Park, NJ (USA). Engineering Technology Dept.). 1979. Contract EX-76-C-01-2471. 52p. NTIS, PC A04/MF A01.

A Process Stream Coking Test Unit has been used to study the parameters affecting coke laydown on the internal surfaces of hydrocarbon containing tubes under conditions of high temperature and heat transfer rate. All test runs have been completed. The data analysis shows that in addition to film temperature, mass velocity is an important parameter in controling coking rate. No coke laydown occurred in any tests run at a mass velocity of 600 lb/sec ft^2 at heat fluxes up to 60,000 Btu/hr ft^2. The High Temperature Heat Flux Test Unit has been put into operation. The first series of tests using propane as the fuel has begun. The operation of the Heat Flux Unit, the range of data collected, and an analysis of the data are described. Construction of the coal and limestone facilities has been completed. It is expected that the first coal fired run will be made during the first quarter 1980. The object of the Economic and Applications Task of the Program is to evaluate the economic and logistic factors that might influence the schedule and circumstances under which coal fired Atmospheric Fluidized Bed Combustion (AFBC) technology might be applied to petroleum and petrochemical plant process heaters. The task has been divided into two phases. The first phase, the Applications Phase, has been completed. The results indicate that the potential for near term applications of AFBC technology to refinery crude heaters is relatively low. Opportunities for applications of AFBC technology outside conventional petroleum refinery environment are now being reviewed.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 33329

PARTICLE ACCELERATORS

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

34066 (LA—8257-PR) **Medium-energy physics program. Progress report, February 1-April 30, 1979.** van Dyck, O.B.; Dunn, E.D. (comps.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 117p. NTIS, PC A06/MF A01.

This report covers most of LAMPF Operating Cycle 23. The H^+ beam intensity averaged 425 μA; low-current polarized and unpolarized H^- beams were also in use. Facility status and operation are reported in detail under the following headings: accelerator operations, accelerator systems, main beam lines, and experimental areas. Approximately one-half of the publication contains brief, preliminary reports of research carried out during this period. 62 figures, 13 tables. (RWF)

34067 (LA--8444-MS) **Monochromatic neutral kaon beam.** Hoffman, C.M. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01.

A design for a monochromatic, neutral kaon (K^0) beam, which could be constructed at a Kaon Factory, is described. Possible uses of such a beam are discussed.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 34426

34068 (BNL—27971) **Single bunch fast longitudinal instability.** Wang, J.M.; Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 11p. (CONF-790787—2). NTIS, PC A02/MF A01.

From Workshop on beam current limitations in storage rings; Upton, NY, USA (16 Jul 1979).

Single bunch longitudinal instability producing an increase of the bunch area have been observed in proton synchrotron and storage rings. Signals at microwave frequencies are observed during the bunch blow-up and because of this the effect has been called the microwave instability. A similar increase in bunch area is observed also in electron storage rings, where it is usually referred to as the bunch lengthening effect. This paper is an attempt to obtain a more general theory of this effect. Here we describe the model used and the method of calculation, together with some general results. More detailed results will be given in another paper. The main result is the derivation of a condition for the existence of a fast longitudinal bunch blow-up. This condition is a generalized threshold formula, showing explicitly the dependence on the bunch energy spread and length. This condition is qualitatively in agreement with Boussard's suggestion.

34069 (BNL—27972) **Tacoma mode.** Courant, E.D.; Ruth, R.D.; Wang, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 3p. (CONF-790787—3). NTIS, PC A02/MF A01.

From Workshop on beam current limitations in storage rings; Upton, NY, USA (16 Jul 1979).

The name Tacoma refers to the Tacoma Narrows Bridge which collapsed on November 8, 1940 due to massive oscillations caused by high winds. One of the destructive modes was a torsion mode which was excited by transverse wind, a dipole force, and continued until the bridge collapsed. The name is used to refer to a coherent mode of oscillation of a spectrum of oscillators in which the amplitude vs frequency graph contains one node, where the node occurs near the driving frequency and a ω is not symmetric about zero. When this result is applied to vertical instabilities in coasting beams, it implies the existence of a coherent skew quadrupole moment, Q/sub xy/, whenever a coherent dipole oscillation exists.

34070 (BNL—28033) **Empirical model for controlling beam-beam effects in ISABELLE.** Parzen, G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 11p. (CONF-8005102—1). NTIS, PC A02/MF A01.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The beam-beam interaction may limit the beam intensity in ISABELLE. Although considerable progress has been made in understanding the beam-beam interaction, there appears to be no reliable method at present for computing the effects of the beam-beam interaction. The steps taken at ISABELLE to limit beam-beam effects are based largely on the experience accumulated at the ISR. At the ISR, the beam-beam effects do not appear to be large, and the beam intensity at the ISR does not appear to be limited by beam-beam effects. The beam-beam effects may be much stronger in ISABELLE because of factors like higher intensity and stronger non-linearities.

34071 (BNL—28131) **Laser driven grating linac.** Palmer, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-800740—12). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The fields induced over a grating exposed to plane parallel light are explored. It is shown that acceleration is possible if either the particles travel skew to the grating lines, or if the radiation is falling at a skew angle onto the grating. A general theory of diffraction in this skew case is given. In one particular case numerical solutions are worked out for some deep grating. It is found that accelerating fields larger even than the initial fields can be obtained, the limit being set by resistive losses on the grating surface. Simple calculations are made to see what accelerating fields might be obtained using CO_2 lasers. Accelerations of 2 or 20 GeV per meter seem possible depending on whether the grating is allowed to be destroyed or not. Power requirements, injection and focussing are briefly discussed and no obvious difficulties are seen. It is concluded, therefore, that the proposed mechanism should be considered as a good candidate for the next generation of particle accelerators.

34072 (LA—8405-MS) **Preliminary simulation studies of accelerator cavity loading.** Faehl, R.J. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01.

Two-dimensional simulations of loading effects in a 350 MHz accelerator cavity have been performed. Electron currents of 1-10 kA have been accelerated in 5 MV/m fields. Higher order cavity modes induced by the beam may lead to emittance growth. Operation in an autoaccelerator mode has been studied.

34073 (LA—8442-MS) **Matching bunched beams to alternating gradient focusing systems.** Lysenko, W.P. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01.

A numerical procedure for generating phase-space distributions matched to alternating gradient focusing systems has been tested. For a smooth-focusing system a matched distribution can be calculated. With a particle tracing simulation code such a distribution can be followed while adiabatically deforming the focusing forces until an alternating gradient configuration is reached. The distribution remains matched; that is, the final distribution is periodic with the structure period. This method is useful because it can produce distributions matched to nonlinear forces. This is a feature that elliptical distributions, with ellipse parameters obtained from the Courant-Snyder theory, do not have. External nonlinearities, including nonlinear couplings, were included in our examples but space charge was not. This procedure is expected to work with space charge but will require a three-dimensional space charge calculation in the simulation code.

34074 (LA-UR—80-1855) **Radio-frequency quadrupole: general properties and specific applications.** Stokes, R.H.; Crandall, K.R.; Hamm, R.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800740—8). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The radio-frequency quadrupole (RFQ) linac structure is being developed for the acceleration of low-velocity ions. Recent experimental tests have confirmed its expected performance and have led to an increased interest in a wide range of possible applications. The general properties of RFQ accelerators are reviewed and beam dynamics simulation results are presented for their use in a variety of accelerating systems. These include the low-beta sections of the Fusion Materials Irradiation Test Accelerator, a 200-MHz proton linear accelerator, and a xenon accelerator for heavy ion fusion.

34075 (SLAC-PUB—2548) **Recent experimental results on the beam-beam effects in storage rings and an attempt of their interpretation.** Kheifets, S. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 30p. (CONF-800740—13; PEP-NOTE—333). NTIS, PC A03/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The latest available experimental results on the luminosity, the space charge parameters, and the beam blowup as functions of particle energy and beam current are reviewed. The comparison with the phenomenological diffusion theory is done and useful scaling laws are derived. Some implications for anti p p storage rings are discussed.

AUXILIARIES AND COMPONENTS

ION SOURCES

34076 (LA-UR—80-1905) **Operating experience and cesium recycling on the LASL polarized triton source.** Hardekopf, R.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—14). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The polarized triton source has had over 3000 hours of operation. Experience gained with Lamb-shift operation that are not unique to tritium handling are discussed. (GHT)

34077 **High current source of He^- ions.** Hooper, E.B. Jr; Pincosy, P.A.; Poulsen, P.; Burrell, C.F.; Grisham, L.R.; Post, D.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Rev. Sci. Instrum.;* **51**: No. 8, 1066-1070(Aug 1980).

A negative helium ion beam of 70 mA at 10.5 kV has been produced by charge exchange in sodium. The production is studied as a function of sodium line density, beam energy and background helium gas density. The characteristics of this high current He^- source are analyzed to determine the design requirements for He^- beam generation in the range of tens to hundred of milliamperes.

INJECTION AND EXTRACTION SYSTEMS

34078 (LA-UR—80-1945) **Injection system for the Proton Storage Ring at LASL. Final report.** Hudgings, D.W.; Jason, A.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800740—7). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The Proton Storage Ring at LAMPF will accumulate a high current of 800-MeV protons by multiturn charge-changing injection. An 800-MeV neutral hydrogen atomic beam, formed by field ionization of H^- ions in a 1.8 T transverse magnetic field, will be stripped to protons by a carbon foil. To minimize peak proton current on the foil, the beam orbit will be deformed so that the edge of the beam grazes the edge of the foil. As the beam diameter grows, the orbit perturbation is decreased, vanishing at the end of the accumulation cycle. The hardware requirements are simple. Single-turn orbit deformation magnets are pulsed to peak field and switched across power dissipation circuits that control the field decay rate. Stripping foil requirements and a method of calculating the desired orbit deformation are described.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 34074, 34093

34079 (BNL—27767) **ISABELLE vacuum systems.** Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 4p. (CONF-800928—1). NTIS, PC A02/MF A01.

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

The Intersecting Storage Accelerator (ISABELLE) consists of two rings having a circumference of 3.8 km each. In these rings superconducting magnets, held at 4 K, bend and focus the proton beam which is accelerated up to 400 GeV. Due to very different pressure requirements, ISABELLE has two completely independent vacuum systems. One, which operates at 1×10^{-11} Torr, provides a very clean environment for the circulating proton beam. Here only ion and titanium sublimation pumps are used to provide the vacuum. The other system maintains superconducting magnet vessels at a pressure below 1×10^{-4} Torr, since at this pressure the gas conduction becomes negligible. In this so-called insulating vacuum system, turbomolecular pumps pump the inadvertent small helium leaks. Other gases are cryocondensed on the cold surfaces of the cryogenic system. The basic element of ISABELLE known as Full Cell containing 45 meters of beam tube, 8 pumping stations, 8 superconducting magnets and complete instrumentation has been constructed, leak checked and tested. All design parameters have been achieved in both vacuum systems. The two vacuum systems are described with particular emphasis on the influence of superconducting magnets in the selection of materials and UHV components.

34080 (BNL—28214) **Uranium scintillator calorimeter at the CERN ISR.** Gordon, H.; Killian, T.; Ludlam, T. (Brookhaven National Lab., Upton, NY (USA); European Organization for Nuclear Research, Geneva (Switzerland); Niels Bohr Inst., Copenhagen (Denmark); Lund Univ. (Sweden)). 1980. Contract AC02-76CH00016. 9p. (CONF-800684—6). NTIS, PC A02/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

The design, Monte Carlo studies and test beam results of a uranium/scintillator calorimeter to be installed in the Intersecting Storage Ring (ISR) at CERN are described. In its final stage the calorimeter will cover the full azimuth over a polar region of $45° < \theta < 135°$. The full calorimeter is built in a modular way from 128 stacks, with each stack internally subdivided into six cells of 20 x 20 cm^2 cross section. The readout is by wavelength shifting (WLS) plates with a separate readout of the front part of the calorimeter (first ten plates) to allow electromagnetic/hadronic separation. Since the readout plates are on both sides of the cells, position information is obtained from the left/right ratio.

34081 (DOE/ER/05023—1) **Proposal for a new neutrino detector at Fermilab to study the weak neutral current. Annual technical progress report.** Taylor, F.E. (Northern Illinois Univ., Dekalb (USA)). 1979. Contract AS02-78ER05023. 31p. (CONF-791037—31). NTIS, PC A03/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

The construction and testing of the 340 ton flash chamber - proportional tube chamber neutrino detector is in progress. To date, 240 tons of the calorimeter are constructed, 320 of the required 600 flash chambers are debugged and are operational, and 15 of the 37 proportional planes are working. Neutrino events in the Fermilab quadrupole triplet beam have been recorded. A calibration of the energy and angle resolution of the calorimeter has been performed. The construction of the remaining 100 tons of the detector is in progress.

34082 (HEDL-SA—2123-FP) **Neutron environment in d + Li facilities.** Mann, F.M.; Schmittroth, F.; Carter, L.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 23p. (CONF-800551—21). NTIS, PC A02/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

A microscopic d + Li neutron yield model has been developed based upon classical models and experimental data. Using equations suggested by the Serber and evaporation models, a generalized least squares adjustment procedure generated angular yields for E/sub d/ to 40 MeV using the available experimental data. The HEDL-UCD experiment at E/sub d/ = 35 was used to adjust parameters describing the neutron spectra. The model is used to predict yields, spectra, and damage responses in the FMIT Test Cell.

34083 (LA-UR—80-1856) **NBS-LASL racetrack microtron.** Penner, S.; Debenham, P.H.; Green, D.C. (National Bureau of Standards, Washington, DC (USA); Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800740—9). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The NBS-LASL racetrack microtron (RTM) is a joint project of the National Bureau of Standards (NBS) and the Los Alamos Scientific Laboratory (LASL). This is a new accelerator research project whose goal is to determine the feasibility of building a high-energy, high-current, cw electron accelerator using beam recirculation and room-temperature rf acceleration structures. The NBS-LASL RTM is being designed and built to develop the required technology for a large national 1 to 2 GeV cw accelerator for nuclear physics research and to prove experimentally that high currents can be accelerated successfully in an RTM. Some of the parameters of the NBS-LASL RTM are 185 MeV final energy, 550 μA maximum current, 15 passes, 12 MeV one-pass energy gain, and 2380 MHz frequency. One 450 kW cw klystron will supply rf power to both the 5 MeV injector and the 12 MeV linac in the RTM.

34084 (SAND—80-1388C) **10^{13}/second 14 MeV neutron generator for cancer therapy.** Walko, R.J.; Bacon, F.M.; Bickes, R.W. Jr.; Cowgill, D.F.; Boers, J.E.; Riedel, A.A.; O'Hagan, J.B. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 27p. (CONF-801037—1). NTIS, PC A03/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

A high output D-T neutron generator is being developed at Sandia National Laboratories as a cancer therapy tool. Preliminary results have been obtained with a high vacuum deuterium accelerator consisting of a duopigatron ion source, single stage accelerator and a scandium occluder target. The ion source and accelerating system have been optimized to reliably focus a 200 mA, 200 kV deuterium ion beam onto the scandium target 1.5 m away with a beam spot size of $10^{-3}m^2$. The scandium target degrades due to implantation of impurities from the unbaked vacuum system. A UHV accelerator is being fabricated which will permit a 450°C bakeout to alleviate the impurity problem. This system will also be compatible with the use of tritium, a necessary component of the therapy machine.

34085 (SLAC-PUB—2526) **SLAC linear collider.** Hollebeek, R. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 8p. (CONF-800374—5). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

A brief description of the proposed SLAC Linear Collider is given. This machine would investigate the possibilities and limitations of Linear Colliders while at the same time producing thousands of Z^0 particles per day for the study of the weak interactions.

STORAGE RINGS

REFER ALSO TO CITATION(S) 34069, 34075

34086 (LA-UR—80-1946) **LASL high-current proton storage rings.** Lawrence, G.P.; Cooper, R.K.; Hudgings, D.W.; Spalek, G.; Jason, A.J.; Higgins, E.F.; Gillis, R.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800740—6). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The Proton Storage Ring at LAMPF is a high-current accumulator designed to convert long 800-MeV linac pulses into very short high-intensity proton bunches ideally suited to driving a pulsed polyenergetic neutron source. The Ring, authorized for construction at $19 million, will operate in a short-bunch high-frequency mode for fast neutron physics and a long-bunch low-frequency mode for thermal neutron-scattering programs. Unique features of the project include charge-changing injection with initial conversion from H^- to H^0, a high repetition rate fast-risetime extraction kicker, and high-frequency and first-harmonic bunching system.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

34087 (CONF-800747—3) **Gamma scattering.** Baker, A.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01.

From Review group conference on advanced instrumentation for reactor safety research; Oak Ridge, TN, USA (29 Jul 1980).

Experimental examinations have been performed on a gamma scattering source/detector configuration that is believed to have the potential for providing density information at a finite number of positions along the primary beam and the average attenuation along the exit rays from those positions. Scattering spectra were acquired for several void-fluid density distribution simulations. The multiple-scattered photon contribution to the total acquired spectrum from a water-filled pipe simulation was extracted and found to be between 18 to 33% of the total counts in the single-scattered photon energy region, with a region average of 24%.

34088 (HEDL-SA—2041) **Tissue equivalent proportional counter neutron monitor.** Smith, R.C.; Strode, J.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1980. Contract AC14-76FF02170. 23p. (CONF-800735—2). NTIS, PC A02/MF A01.

From Healthy Physics Society summer school; Seattle, WA, USA (14 Jul 1980).

The Tissue Equivalent Proportional Counter (TEPC) is a sensitive area monitoring instrument that can be used either in place at fixed locations or as a portable neutron exposure measuring device. The system monitors low levels of neutron radiation exposure and has the capability of accurately measuring neutron exposure rates as low as 0.1 mrem/hr. The computerized analysis system calculates the quality factor which is important for situations where the neutron to gamma ratio may vary significantly and irregularly such as in fuel fabrication or handling facilities.

34089 Compensated count rate circuit for portable Geiger-Mueller survey meter. Todd, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Rev. Sci. Instrum.;* **51**: No. 8, 1132-1134(Aug 1980).

A count rate circuit is described that better compensates for counting losses due to detector dead time than previously used techniques in Geiger—Mueller survey meters. Bench tests show the new design response to be within 1% of the ideal response even up to counting losses of 50%.

34090 New small-angle neutron scattering (SANS) instrument at ORNL using a position-sensitive area detector. Child, H.R. (Oak Ridge National Lab., TN (USA)); Spooner, S. (Georgia Inst. of Tech., Atlanta (USA)). *J. Appl. Crystallogr.;* **13**: No. 3, 259-264(1 Jun 1980).

The small-angle neutron scattering (SANS) machine in operation at the Oak Ridge Research Reactor (ORR) has shown the usefulness of the Borkowski-Kopp two-dimensional position-sensitive proportional counter used with double pyrolytic-graphite-crystal monochromators. Although built with little latitude for machine optimization, it is capable of performing useful research in cases involving large scattering cross sections. Many of this machine's features are prototypic to the new machine under construction at the High-Flux Isotope Reactor (HFIR) for the National Center for Small-Angle Scattering Research.

34091 Germanium semiconductor detector efficiency determination using a standard Marinelli (reentrant) beaker geometry. Costrell, L. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research); Persyk, D.E. (Searle Radiographic Inc., Des Plaines, IL (USA)); Sanderson, C. (Department of Energy, New York (USA). Environmental Measurements Lab.); Walford, G.; Walter, F.J. (EGG-ORTEC, Oak Ridge, TN (USA)). *Health Phys.;* **38**: No. 2, 229-232(Feb 1980).

34092 Response of a fast neutron criticality monitor to prompt critical bursts. Straume, T.; Friesen, R.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Health Phys.;* **38**: No. 2, 236-238(Feb 1980).

A neutron-sensitive criticality monitor has been developed at the Lawrence Livermore Laboratory. The monitor's response characteristics to a nuclear criticality accident and to high ambient gamma and neutron radiation fields has been determined by exposure to actual prompt critical bursts using the Super Kukla fast burst reactor at the Nevada Test Site. The monitor head is composed of an (n,p) recoil plastic scintillator, photomultiplier tube, operational amplifier, power supply, calibration light and tantalum shield. The monitor detects most efficiently neutrons of about 10 MeV. Below 3 MeV, the detection efficiency decreases sharply. The detection efficiency for gamma radiation is low and can be further decreased by adding more tantalum around the detector. Results of the burst tests show that the smallest credible criticality accident will readily initiate an alarm. The monitor has been in use for about 2 years without false alarms.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 34080, 34081

34093 (BNL—28132) **New ideas in calorimetry.** Gordon, H.A.; Palmer, R.B; Smith, S.D. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 24p. (CONF-800684—4). NTIS, PC A02/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

The problem of operating calorimeters which use scintillators in a strong magnetic field is explored. Ideas include using double wave shifting techniques to concentrate the light into a small area and then measuring it in place with solid state devices or microchannel plate photomultipliers or shipping the light remotely to normal phototubes via flexible light guides. Some novel schemes of casting plastic sheets with heavy metals for gas sampling calorimeters will also be discussed.

34094 (COO—3071-245) **Some energy resolution effects for hadron jets in a calorimeter array.** Selove, W.; Mehanian, C.; Winterberg, J.; Yost, B. (Pennsylvania Univ., Philadelphia (USA)). May 1980. Contract AC02-76ER03071. 16p. (CONF-800684—2; UPR—75E). NTIS, PC A02/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

A calorimeter array, modular three-dimensionally, was used in experiment E-395 (FLPW) at Fermilab. Calibration curves were taken with monoenergetic beams of hadrons and electrons. In a typical hadron jet PI^0's and other hadrons intermingle their energy showers in the calorimeter. A simple signal weighting prescription was used, for modules at different depths, to obtain the true p/sub TAU/ spectrum from the apparent p/sub TAU/ spectrum. This prescription has been tested with Monte Carlo simulated jets, by M.D. Corcoran and A.R. Erwin, and found to permit extraction of physics results from the experimental jet data. Here we report some further studies of the adequacy of this weighting procedure, and the sensitivity of the resolution unfolding procedure to variations in the resolution curves.

34095 (LA-UR—80-1943) **Polarimeter for protons between 300 and 800 MeV.** Ransome, R.D.; Hollas, C.L.; Greene, S.J.; Bonner, B.E.; McNaughton, M.W.; Morris, C.L.; Thiessen, H.A. (Texas Univ., Austin (USA); Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 3p. (CONF-800824—18). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

A polarimeter for protons between 300 and 800 MeV has been constructed. It uses a carbon block analyzer of variable thickness and 6 drift chambers for particle tracking.

34096 End of bubble chamber era. *CERN Cour.;* **20**: No. 2, 55(Apr 1980).

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 33331, 33745, 33765, 33766

34097 (CONF-800719—11) **Soft x-ray transmission gratings.** Arakawa, E.T.; Caldwell, P.J.; Williams, M.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From International symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (28 Jul 1980).

A technique was developed for producing transmission diffraction gratings suitable for use in the soft x-ray region. Thin self-supporting films of a transparent material are overlaid with several thousand opaque metallic strips per mm. Gratings with 2100, 2400, and 5600 l/mm have been produced and tested. Representative spectra over the wavelength range from 17.2 to 40.0 nm are given for a grating consisting of a 120-nm-thick Al support layer overlaid with 2400, 34-nm-thick, Ag strips/mm. The absolute transmittance is ~ 13% at 30 nm, and the efficiency in the first order is ~ 16%. The observed resolution of ~ 2A is acceptable for many of the potential applications. These gratings have several advantages over the two presently available alternatives in the soft x-ray region (i.e., reflection gratings used at grazing incidence and free-standing metallic wire transmission gratings). Fabrication is relatively quick, simple, and cheap. The support layer can also serve as a filter and help conduct excessive heat away. Higher line densities and hence higher resolutions are possible, and when used at normal incidence the spectra are aberration free. Suitable materials, component thicknesses, and line densities can be chosen to produce a grating of optimum characteristics for a particular application.

34098 (EGG—1183-2369) **Laboratory evaluation of an N_2 laser fluorosensor.** Franks, L.; Capelle, G. (EG and G, Inc., Goleta, CA (USA)). Dec 1977. Contract AC08-76NV01183. 39p. NTIS, PC A03/MF A01.

A laboratory version of a fluorosensor consisting of a 5-kW nitrogen laser, an 8-inch f/10 Cassegrainian telescope fitted with an RCA C31005C photomultiplier, and readout electronics, was assembled and tested. Detection sensitivity of the system was measured using two different combinations of optical filters, one primarily for daylight use and one exclusively for nighttime operation. System sensitivity was measured using a standard quinine bisulfate solution (in 0.1 N H_2SO_4); the smallest concentration that could be detected was 8.0 x 10^{-7} g/l with the nighttime set and 9 x 10^{-5} g/l with the daytime set. A concentration of 9.8 x 10^{-6} g/l was detected using the daytime set at night. The fluorescence of effluents from several DOE coal treatment facilities was also measured.

34099 (LBL—11017) **Normal emission photoelectron diffraction: a new technique for determining surface structure.** Kevan, S.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 177p. NTIS, PC A09/MF A01.

Thesis.

One technique, photoelectron diffraction (PhD) is characterized. It has some promise in surmounting some of the problems of LEED. In PhD, the differential (angle-resolved) photoemission cross-section of a core level localized on an adsorbate atom is measured as a function of some final state parameter. The photoemission final state consists of two components, one of which propagates directly to the detector and another which scatters off the surface and then propagates to the detector. These are added coherently, and interference between the two manifests itself as cross-section oscillations which are sensitive to the local structure around the absorbing atom. We have shown that PhD deals effectively with two- and probably also three-dimensionally disordered systems. Its non-damaging and localized, atom-specific nature gives PhD a good deal of promise in dealing with molecular overlayer systems. It is concluded that while PhD will never replace LEED, it may provide useful, complementary and possibly also more accurate surface structural information.

34100 (SAND—80-8222) **Pico amp measurement circuit with high system isolation.** Akins, J.H. (Sandia National Labs., Livermore, CA (USA)). Jun 1980. Contract AC04-76DP00789. 11p. NTIS, PC A02/MF A01.

An increase in sensitivity of 2000 can be achieved by modifying a Tektronics P6042 Hall Effect probe to accept 2000 turns as opposed to the standard single turn current input line. This increase in sensitivity coupled with a special self-zeroing amplifier allows the measurement of Pico-amps while maintaining high system isolation.

34101 **Wide range high sensitivity film balance.** Abraham, B.M.; Miyano, K.; Buzard, K.; Ketterson, J.B. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Rev. Sci. Instrum.;* **51**: No. 8, 1083-1087(Aug 1980).

A film balance has been constructed that features a wide range (~80 dynes/cm) and high sensitivity (~10^{-3} dyne/cm). The device is rugged, simple to operate and can be repeatedly assembled/disassembled in cycles (for cleanings) without affecting its mechanical parameters (nullpoint and sensitivity).

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 33957

34102 (MLM—2762(OP)) **Mound Facility explosives incinerator.** Harrison, J.L.; Lonadier, F.D.; Wirth, G.R. (Monsanto Research Corp., Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 5p. (CONF-800941—2). NTIS, PC A02/MF A01.

From 19. DOD explosives safety seminar; Los Angeles, CA, USA (9 Sep 1980).

The design and performance of small incinerators used at the Mound Laboratory for the disposal of explosives are described. These units, which cost less than $1000 each, are about the size of a 55-gal drum, have water jackets for cooling, and have provided a flexible, efficient, and clean burning explosives disposal unit. (LCL)

34103 (SAND—80-1157) **Deflagration-to-detonation transition project: quarterly report for the period September through November 1979.** Lieberman, M.L. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01.

The activities of the Sandia Laboratories project on deflagration-to-detonation transition (DDT) pertain primarily to the development of small, safe, low-voltage, hot-wire detonators. Its major goals are: the formulation of a modeling capability for DDT of the explosive 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate (CP); the development of improved DDT materials; the establishment of a data base for corrosion, compatibility, and reliability of CP-loaded detonators; and the design and development of advanced DDT components. Progress in this research is reported. The planned development of the MC3423 detonator has been completed and the final design review meeting has been held. Additional work must be performed to establish satisfactory output function. Ignition sensitivity data have also been obtained. Ignition and shock testing experiments for development of the MC3533 detonator have been planned. An initial version of the component will utilize available MC3423 headers, while the final design will incorporate a new header that has been designed and ordered. Detonator performance studies have been planned to optimize CP density-length factors. Feasibility studies on the MC3196A detonator have continued in an effort to obtain a reliable 50-200 μs function time.

34104 (SAND—80-8216) **Sensitivity experiments: a one-shot experimental design and the ASENT computer program.** Mills, B.E. (Sandia National Labs., Livermore, CA (USA)). Aug 1980. Contract AC04-76DP00789. 34p. NTIS, PC E02/MF $3.50.

Sensitivity experiments are commonly used for testing and/or certifying materials such as explosives exposed to stimuli such as sparks. These materials are distinguished by the facts that all samples do not react identically to the stimulus, that each sample can only be tested at one stimulus level and that the result of any test can be defined as either positive or negative (with no intermediate results). For each sample it is assumed that there is a critical stimulus level above which the result of a test would be positive and below which it would be negative (or vice versa). This critical stimulus level is a continuous variable which characterizes the population of samples of the material and which cannot be measured because each sample can only be tested once. It can, however, be inferred from the results of testing samples at various stimulus levels. This requires a large number of samples. Methods have been developed to minimize the number of samples required by experimental design on the assumption that the response follows a nomal distribution and that there are no duds. In this paper an experimental design based on the assumptions of a normal distribution and no duds, but which is independent of prior estimates of the mean and the standard deviation, is explained. Monte Carlo experiments were performed using three different types of experimental designs and both good and bad prior estimates of the mean on standard deviation. The results indicate that the design explained here is more flexible than older experiment designs. A computer code is also explained which, although not originally designed to reduce data from this source, can be used to give estimates of the mean, the standard deviation and the percentiles (or LDs) based on data from this test design.

34105 (UCRL—52921) **Design of a maze structure to attenuate blast waves.** Bacigalupi, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Mar 1980. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

Building criteria for cells used to process and store high explosives dictated maze-type entries, to avoid mechanical closure devices. Experiments were conducted to develop a minimum-cost maze configuration that would limit the effects of an accidental 10-kg detonation to acceptable levels (<15 psig reflected) in adjacent areas. Components of suppressive design that were considered were right-angle turns, blast deflectors, baffles (reduced-area openings), and energy-absorbing materials. The proposed configuration uses multiple baffles and a blast deflector to reduce the exit pressure to about 8 psig reflected.

34106 (UCRL—84587) **Temperature measurements of shocked energetic materials by time-resolved infrared radiometry.** von Holle, W.G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 21p. (CONF-800714—2). NTIS, PC A02/MF A01.

From NATO advanced study institute on fast reactions in energetic systems; Ioannina, Greece (6 Jul 1980).

Temperatures of solid explosive and propellants were measured in 102 mm projectile-impact experiments using two-band, time-resolved infrared radiometry. Two different arrangements were used. In one, temperature measurements were made on the downstream face of bare charges; in the other, the material was confined by a shock-impedance matched, infrared-transmitting window. The bare-charge results yield temperature histories consistent with formation and decay of hot spots, and different particle sizes resulted in large differences in behavior, which were interpreted in terms of hot spot theory. Window confinement provided reaction histories and rate data which constitute a new measurement of progress of reaction in shock initiation.

NUCLEAR

34107 (AD-A—076489) **Nomograms for overpressure, fireball radius and thermal energy of nuclear weapons. Technical information series.** Cramer, W.E. (General Electric Co., Syracuse, NY (USA). Heavy Military Equipment Dept.). Aug 1979. 11p. NTIS, PC A02/MF A01.

The effects of nuclear explosions have been known for more than three decades, and phenomena that emit the largest portions of energy are the overpressure (blast wave) and thermal radiation. Nomograms are presented that quickly provide first-cut estimates of the emitted peak-exposure levels. These levels are then related to: (1) the resulting damage effects of various structures and materials and (2) the biological effects on humans and animals.

34108 (USGS-OFR—80-817) **Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979.** Glanzman, V.M. (Geological Survey, Denver, CO (USA). Geologic Div.). 1980. Contract AC13-76GJ01664. 25p. NTIS, PC A02/MF A01.

This bibliography presents reports released to the public between January 1, 1979, and December 31, 1979, by personnel of the US Geological Survey. Reports include information on underground nuclear testing and waste management projects at the NTS (Nevada Test Site) and radioactive waste projects at the WIPP (Waste Isolation Pilot Plant) site, New Mexico. Reports on Project Dribble, Tatum Dome, Mississippi, previously prepared as administrative reports and released to the public as 474-series reports during 1979 are also included in this bibliography.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 33270, 34121, 34133, 34134

34109 (ANL/EES-TM—93) **Investigation of the interaction of an SPS rectenna with its environment.** Robinson, G.D. (Center for the Environment and Man, Inc., Hartford, CT (USA)). Jan 1980. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01.

The effects of a single Satellite Power System rectenna array on weather and climate were studied. Through numerical simulation the effects of rectennas on atmospheric local circulations and cloud and precipitation processes were estimated quantitatively. The simulation indicated that in the chosen situation the weather/climate effect of installation and operation of the rectenna is small, particularly outside the boundary of the structure. (JGB)

34110 (BNL—51149) **Atmospheric boundary layer measurements during summer MONEX 79 at Digha, India.** SethuRaman, S.; Michael, P.; Tuthill, W.A.; McNeil, J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract AC02-76CH00016. 37p. NTIS, PC A03/MF A01.

Marine boundary layer experiments conducted over the Bay of Bengal at Digha Beach, West Bengal, India, as part of the International Monsoon Experiments (MONEX 79) are described. The experiments consisted of measurements of atmospheric turbulence and fluxes of momentum, heat, and water vapor from a 10-m-high coastal meteorological tower. Mean meteorological parameters were measured with an automated electronic weather station. Wind speed and direction profiles were obtained with pilot balloon soundings. Some typical tropical meteorological features photographed during the experiment are also presented.

34111 (CONF-790520—, pp III.69.1-III.69.11) **Environmental planning and assessment for highway vehicle use of alcohol fuels.** Bernard, M.J. III; Bevilaqua, O.M. Apr 1980.

From 3. international symposium on alcohol fuels technology; Asilomar, CA, USA (28 May 1979).

Argonne National Laboratory (ANL) is assisting the Office of Transportation Programs (OTP) of the US Department of Energy in performing the required environmental planning and assessment for highway vehicle alcohol fuel commercialization in accordance with the National Environmental Policy Act of 1969 (NEPA). In this presentation the process for planning and assessment is given, specific documents resulting from the process are explained. NPA requires an environmental impact statement (EIS) for every major federal action that may have a significant impact on the quality of the human environment. The EIS is subject to public review, according to DOE's guidelines. The environmental assessment process, as described in the DOE guidelines and as implemented by OTP will result in environmentally sound demonstration and commercialization of alcohol fuels. The term environment is defined very broadly to include the ecosystem, resource, physical environment, health, safety and socioeconomic subsystems. Three types of environmental documents record this process: the Environmental Development Plan (EDP), the Environmental Assessment (EA) and the Environmental Impact Statement (EIS). The transportation EDP describes the energy conserving technologies; identifies and ranks environmental concerns; outlines strategies to resolve the concerns on a priority basis; and proposes a research program to implement the strategies. This is done annually for the division. In addition, environmental documentation is scheduled for each technology as it reaches different stages of development. One major document is the EA, prepared when it is not clear whether an EIS is necessary. The information to make such a decision is collected in one detailed assessment of the technoloy or program. An EIS may then be written if impacts are expected to be significant. An EA is being performed for alcohol (neat and blends) fuels for highway vehicles by ANL.

34112 (COO—1340-75) **Further study of the variability in the frequency of typhoon formation over the West Pacific ocean.** Ding, Y.H.; Reiter, E.R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1980. Contract AS02-76EV01340. 84p. NTIS, PC A05/MF A01.

This paper presents a study of the variability in the frequency of typhoon formation over the West Pacific ocean, emphasizing the effects of the large-scale sea-air system on the activity of typhoons. Some important relationships between typhoon formation and the climatological aspect of air-sea interaction are pointed out.

34113 (COO—1340-76) **Effects of atmospheric variability on energy utilization and conservation. Progress report.** Reiter, E.R.; Burns, C.C.; Cochrane, H.; Johnson, G.R.; Leong, H.; Sheaffer, J.D. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Jul 1980. Contract AC02-76EV01340. 86p. NTIS, PC A05/MF A01.

Research progress for the period September 1979 to July 1980 is reported. Research was structured along four major tasks: (1) atmospheric circulation and climate variability; (2) urban mesoclimate; (3) energy demand modelling; and (4) economic implications of weather variability and energy demand: stimulating residential energy conservation through the financial section. (ACR)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33778, 33801, 33810, 33843, 33844, 34148

34114 (AD-A—076578) **Measurements of jet dispersions simulated in an aeronautical wind tunnel.** Brendmoen, J.V. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1979. 94p. NTIS, PC A05/MF A01.

Thesis.

A neutrally stable atmospheric surface layer was suitably simulated in a low speed wind tunnel by tripping the boundary layer with a fence and letting the turbulent flow develop over a length of roughness elements. Jet exhaust disperion characteristics, simulated by a burner/nozzle system, were investigated by measuring the horizontal and vertical temperature profiles at axial stations downwind from the nozzle exit. Dispersion sensitivity to different nozzle exit conditions, angles of incidence to the wind, the nozzle surface blockage were investigated. The results were compared to disperison methods used in the Air Quality Assessment Model (AQAM). It was found that the experimental jet penetration length was much shorter than that assumed in AQAM, and that a plume rise existed, which is not included in the current AQAM model. Required inputs of the initial dispersion coefficients were determined as a function of wind direction.

34115 (BNL—51118, pp 141-156) **Health hazard evaluation determination. Appendix.** (FMS Corp., Broomfield, CO). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) on August 27 and September 8, 1976, at the FMC Corporation in Broomfield, Colorado. At the time of this evaluation, breathing zone samples were taken for methanol, ethyl acetate, isopropyl alcohol, copper, nickel, tin, trichloroethylene, acetone, Freon-11/sup R/, chloroform, hydrochloric acid, nitric acid, aluminum oxide, and hydrofluoric acid. Results are reported. Concentrations of chloroform and Freon-11/sup R/ exceeded the most recent evaluation criteria. A health hazard existed at the time of this evaluation to both chloroform and Freon-11/sup R/.

34116 (CONF-800814—11) **Environmental and health aspects of biomass energy systems.** Braunstein, H.M.; Kornegay, F.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

In a recent study undertaken to ensure the early incorporation of environmental considerations in decisions concerning biomass-to-energy systems, a number of issues emerged indicating the need for early attention to environmental, socioeconomic and health concerns. Both production of biomass as well as conversion can lead to environmental impact, and although most impacts will be site-specific, some generic effects can be identified. The most important potential impacts arise first, from the need for large-scale commitment of resources for production, and second, from uncontrolled widespread small-scale utilization. Because biomass-related impacts cover a very broad spectrum of materials, processes, end products, and effects, the discussion presented here, except for an overview of generic effects and comment on production impacts, will be directed primarily to those resulting from residential wood combustion.

34117 (DOE/EV/00641—42) **Rainfall element content and acidity from April 30, 1976 to February 17, 1978, Athens, Georgia.** Haines, B.L.; Nabholz, J.V.; DuBois, S. (Georgia Univ., Athens (USA). Inst. of Ecology). 1 Aug 1980. Contract AS09-76EV00641. 23p. NTIS, PC A02/MF A01.

Precipitation from 99 storm events between April 30, 1976 and February 17, 1978 had pH values ranging from 3.2 to 4.8 with median pH of 4.1. A subset of samples spanning one year from October 1976 through September 1977 had a volume weighted average pH of 4.19 as determined at time of collection and a volume weighted average of 4.44 after being stored frozen, thawed, and purged with N_2 gas. SO_4 appeared to be the greatest determinant of rainfall acidity. Rainfall with a pH lower than 5.6 resulting from equilibration of pure water with atmospheric CO_2 at 25°C can be termed acid rain. According to this definition, the volume weighted average rainfall in north Georgia is acid rain, confirming inferences made by Likens (1976), using data from bordering states, that acid rain occurs in Georgia. Comparison of volume weighted pH values from Athens with values from Coweeta, North Carolina and Gatlinburg, Tennessee, suggest that acid rain is a regional problem in the Southeast.

34118 (EPA—600/8-80-020) **EPA energy/environmental control technology program. EPA program summary.** Jacoff, F.S. (ed.). (Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology). Apr 1980. 19p. Environmental Protection Agency, Office of Environmental Engineering and Technology, Washington, DC.

The goal of EPA's energy/environment program is to assure that the nation can accomplish the transition from over-dependence on oil and gas to greater use of abundant domestic coal resources and other alternative fuels, without undue degradation of the environment. The control technology program is comprised of six subprograms: fuel extraction; fuel processing, preparation, and advanced combustion; flue gas sulfur oxide control; nitrogen oxide (NO/sub x/) control; flue gas particulate control; and environmental impacts of conventional and advanced energy systems. Management, coordination, and funding of the program are discussed. (JGB)

34119 (EPA/600/9—79-019) **Sulfur emission: control technology and waste management.** (Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry). May 1979. 33p. Environmental Protection Agency, Washington, DC.

The world's industralized societies are responsible for about 65 millin tons of SO_2 pollutants being discharged into the atmosphere each year. Increasing worldwide demand for energy will make this situation worse by the year 2000. The burning of coal will decrease dependence on foreign oil, but there will be severe pollution problems. The extent and kind of pollution problems and legislation governing control are discussed. Flue-gas desulfurization (FGD) technology is the only control technology commercially available that can be used to reduce sulfur oxide emissions to comply with the Clean Air Act. Using low-sulfur coal, converting to oil or gas, or physically cleaning coal are other options available to reduce sulfur oxide emissions. FGD systems can be classified into nonregenerable or throwaway systems and regenerable or recovery systems. Fluidized-bed combustion is a technology showing potential for a clean-burning process. Coal gasification and liquefaction are additional technologies under development to reduce SO_2 emissions. Management of solid wastes for electric utilities and industrial plants using throwaway FGD control systems is discussed. Disposal of untreated FGD wastes include ponding, landfill, and mines. Chemical fixation and forced oxidation are treatment systems discussed. Waste management will be of concern when fluidized-bed combustion may displace FGD in the post-1985 period. Alternatives to FBC waste disposal methods are examined.

34120 (EPRI-EA—1492) **Development of a particulate sulfate analyzer. Final report.** Mueller, P.K.; Collins, J.F. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Aug 1980. 143p. NTIS, PC A07/MF A01.

An improved method of routinely measuring atmospheric particulate sulfates would not only promote a better understanding of a relationship between gaseous and particulate sulfur compound emissions and ambient sulfates, but would also provide a cost-effective means of monitoring compliance with air quality standards for sulfates. Therefore, a project was undertaken to develop an analyzer that would be suitable for routine ground-based monitoring. Two commercially available flame photometric sulfur gas analyzers were selected as candidates for modification: a Monitor Labs 8450 and a Meloy Labs 285. The Meloy Labs 285 Sulfur Gas Analyzer was modified into the MERT 285 particulate sulfate analyzer. In the MERT 285, sulfur gases are removed from the aerosol being sampled as they flow through a silver oxide-based diffusion denuder. The FPD signal is then integrated to provide readings down to 0.1 μgSO_4 /m^3. The response of the MERT 285 per sulfur atom is essentially equal for H_2SO_4, $(NH_4)_2SO_4$, $MgSO_4$ and SO_2. In ambient air tests, lower quantifiable limits of about 5 $\mu gSO_4/m^3$ were achieved. The performance of the MERT 285 under air quality sampling conditions compares favorably with the performance of continuous sulfate analyzers concurrently being developed by other researchers. Three-hour averaged responses of the MERT 285 agreed with 3-hour filter-sampled sulfate values and yielded a correlation coefficient of 0.97.

34121 (EPRI-EA—1498(Vol.1)) **Plume conversion rates in the SURE Region. Final report.** Easter, R.C.; Busness, K.M.; Hales, J.M.; Lee, R.N.; Arbuthnot, D.A.; Miller, D.F.; Sverdrup, G.M.; Spicer, C.W.; Howes, J.E. JR. (Battelle Columbus Labs., OH (USA)). Aug 1980. Contract AC06-76RL01830. 177p. NTIS, PC A09/MF A01.

Results of a study of transformation and transport processes in plumes emitted from fossil-fueled power plants are described. Primary research emphasis was placed upon transformations of sulfur and nitrogen oxides, with the principal objective of generating parameterized transformation relationships suitable for input to models currently being developed. Extensive field measurements were performed in late spring and late fall of 1977 at two coal-fired and one oil-fired power plants; the Breed plant in Indiana, the Cobb plant in Michigan, and the Andrus plant in Mississippi. Plume measurements were obtained using an instrumented DC-3 aircraft and included gas concentrations (SO_2, NO/sub x/, O_3, HNO_3, hydrocarbons), aerosol composition (SO_4/sup =/, NO_3^-, NH_4^+), and physical aerosol parameters. Source emission measurements were also performed and SF_6 tracer released into the plumes. The resulting data, which include 140 hours of aircraft measurements, have been organized into a data base. Conversion and loss rates of SO_2 and NO/sub x/ were estimated using a variety of ratio techniques, and the results were analyzed using reactive plume models of varying complexity. A parameter-search technique was developed to utilize a reactive plume model to establish candidate conversion expressions for SO_2 transformations. SO_2 was generally found to oxidize in power plant plumes at rates ranging from 0 to 3%/h, depending upon insolation, plume dispersion, and ambient hydrocarbon concentration, as well as a variety of possible additional factors.

Nitrogen oxides data suffer from lower measurement sensitivity, but preliminary indications are that nitrate and nitric acid production proceeds quite slowly in plumes, although substantial total NO/sub x/ losses were sometimes observed.

34122 (EPRI-WS—79-163) **Workshop: data management needs for atmospheric deposition.** Gibson, J.H. (Colorado State Univ., Fort Collins (USA). Natural Resources Ecology Lab.). Aug 1980. 33p. (CONF-790259—(Summ.)). NTIS, PC A03/MF A01.

From Data management needs for atmospheric deposition workshop; Washington, DC, USA (22 Feb 1979).

With the recent organization of the National Atmospheric Deposition Program atmospheric chemistry monitoring network it became evident that there was a need for a data management system to store and make readily available the extensive data base that would be generated. Such a system needed to be designed to handle data from other US atmospheric monitoring networks, as well as non-US networks as for example the Canadian CANSAP program. A workshop was organized to address this question of data management requirements. The attendees representing major US and Canadian studies agreed that a data management function was critical if assessment of the data with respect to the effects of atmospheric deposition was to be successful. In addition, the data are critical to those involved in the studies of atmospheric chemistry and transport. It was agreed that a single system could serve many programs and a statement was prepared stating the required characteristics and capabilities of the data management function. It was recommended that development and support of such a system should be the responsibility of a federal agency and the offer by the EPA to assume this responsibility was strongly endorsed.

34123 (IS—4709) **Assessment of needs for environmental controls for burning a coal-oil mixture in a slot forge furnace.** Shanks, H.R. (Ames Lab., IA (USA)). Jun 1980. Contract W-7405-ENG-82. 40p. NTIS, PC A03/MF A01.

An environmental study was completed on the use of a 56% powdered coal - 44% fuel oil slurry as fuel in an experimental slot forge furnace designed by Hague International. Measurements were made on the stack emission levels for particulates, NO/sub x/, SO/sub x/, and chlorine. Noise and particulate levels in the working area were also determined. Also, estimates were made of ambient particulate concentrations. The data show that the coal-oil mixture can be used as a fuel in a slot forge furnace in many areas but some stack particulate collection will be required in some states. A 75% reduction in particulate emissions would allow the furnace to be located in all but one of the states. Routine use of the fuel will require some minor furnace modification to satisfy OSHA ambient work area regulations.

34124 (IS-M—285) **Adsorption of moisture by grain dust and control of dust hazards.** Chiotti, P.; Yoshizaki, S. (Ames Lab., IA (USA); Tsukuba Univ., Sakura, Ibaraki (Japan)). 1980. Contract W-7405-ENG-82. 32p. (CONF-800953—1). NTIS, PC A03/MF A01.

From Annual meeting of the Fine Particle Society; Washington, DC, USA (16 Sep 1980).

Literature data on the theory of drying thin layers of grain was reviewed and mean values of the diffusion constant calculated. Kinetic data for the reverse process, the adsorption of moisture by grain, is very limited. No data were found on the adsorption or desorption of moisture by grain dust particles suspended in air. Accepting a diffusion mechanism and the diffusion constants obtained from the data on grain kernels, the time required for a small dry particle of dust, 100 to 20 μm diameter, to reach 80% equilibrium moisture content in air at 23°C was calculated to be in the range of 84s to less than one second. Experimental data were obtained on the adsorption of moisture from humidified air by corn dust of different size fractions ranging from 0.894 to less than 0.074 mm dia, by corn starch and by corn meal. A diffusion mechanism appears to be valid for the larger dust particles. Difficulty in obtaining a uniform dispersion of the smaller particles in air and apparatus limitations made it impossible to confirm or disprove theoretical predictions. However, the attainment of 14 to 15% moisture in initially dry dust within one minute was demonstrated. The results indicate that the introduction of humidified air in an enclosed grain conveying system may greatly reduce the dispersibility and explosibility of the grain dust.

34125 (LBL—11237) **Formation and destruction of pollutants in combustion processes: clearing the air on the role of combustion research.** Sawyer, R.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 40p. (CONF-800809—6). NTIS, PC A03/MF A01.

From 18. combustion symposium; Waterloo, Canada (17 Aug 1980).

The first use of fire was no doubt accompanied by the production of air pollutants. The connection between the burning of coal and air pollution was well recognized by the seventeenth century. Even the impact of the automobile on air pollution was anticipated more than a hundred years ago. The rapid increase in the combustion of fossil fuels of the past thirty years has resulted in well identified air pollution problems on both local and global scales. Five pollutant categories are discussed: the direct pollutants (CO, SO_2, particulates, and nitrogenous compounds); acid rain; photochemical smog; carbon dioxide; and carcinogens. Emission standards for cars and light duty trucks are tabulated. The application of combustion research and technology has provided an efficient means, often the most cost effective, of reducing pollutant emissions. The fundamental understanding of the chemical and physical processes leading to the formation of pollutants has been critical to the modification of combustion processes for the minimization of pollutants. Both the prevention of formation and the promotion of destruction of pollutants have proven effective. While thermochemistry shows that there is no conflict between a reduction of pollutants and an increase of efficiency of the combustion processes, in application, compromise solutions have led, on occasion, to such trade-offs. Chemical kinetics can produce time scales for pollutant formation and destruction which are difficult to manipulate in practical combustors in a manner compatible with efficient combustion. The processing of combustion products to remove pollutants has been used, in some cases as the only possible approach, in other cases for pragmatic reasons or because combustion solutions were not pursued aggressively.

34126 (NLM/TIRC—80/2) **Asbestos in air. A bibliography with abstracts, 1964-1980.** Pruett, J.G.; Winslow, S.G. (Toxicology Information Response Center, Oak Ridge, TN (USA)). Jul 1980. Contract W-7405-ENG-26. 58p. NTIS, PC A04/MF A01.

This publication is an annotated bibliography spanning the years 1964 to present. Arranged in alphabetic order by author's last name, this bibliography includes references pertaining to quantitative methods of determining airborne asbestos particles and quantitative levels of atmospheric asbestos fibers. A permuted title index (KWOC) appears at the end of the bibliography.

34127 (NP—25069) **Dispersion modeling of a plume in the tar sands area. Syncrude environmental research report, 1980-1981.** Slawson, P.R.; Davidson, G.A., Maddukuri, C.S. (Envirodyne Ltd., Waterloo, Ontario (Canada)). Dec 1979. 340p. NTIS (US Sales Only), PC A15/MF A01.

The plume rise, spread and supporting meteorological and source data given in Slawson et al (1978) were further analyzed in order to provide a more suitable data set upon which a site-tuned plume dispersion model could be developed. This dispersion model was considered to consist of a buoyant plume rise and growth phase followed by an atmospheric (Gaussian) dispersion phase. Some effort was spent in developing and testing a predictive one-dimensional planetary boundary layer model. Both analytical and simple numerical integration plume rise and growth models are described and tested against a reduced set of observed time-mean plume behavior. The numerical integration plume rise models (NIM) proved to be superior to the analytical models for the GCOS plume. The aircraft inplume transect data were re-analyzed in an attempt to reduce scatter and obtain more consistent standard deviations of plume spread (sigmas) and their rates of growth under various atmospheric stability conditions. Plume cross-section isopleths were constructed from the aircraft transect data for all cross-sections flown. The sigma data abstracted from the isopleths had less scatter than that found previously and correct trends in the data were noted. A sigma typing scheme due to Briggs (1975) was selected as best representative of that observed in the absence of cross-wind shear. Since an equivalent Gaussian plume dispersion model was required a tentative empirical formulation for the effects of cross-wind shear enhanced diffusion was extracted from the data. Also, a model that incorporates the effect of plume distortion directly into a modified Gaussian plume model is described and tested against observed plume cross-sections. A plume rise and Gaussian dispersion model based on these measurements of the GCOS plume is described and tested against observed ground plane aircraft transect data.

34128 (ORNL/TM—7417) **Tracking of smokestack and cooling tower plumes using wind measurements at different levels.** Miller, R.L.; Patrinos, A.A.N. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

Relationships between cooling tower and smokestack plumes at the Bowen Electric Generating Plant in northwestern Georgia and wind direction measurements at levels from the surface at 850 mb (~ 1.5 km) are examined. The wind measurements play an important role in estimating plume directions which in turn are utilized to establish control and target (upwind and downwind) areas for a study of plant-induced precipitation modification. Fifty-two plume observations were made during a three week period in December 1979. Results indicate that a windset (4.5 km from the plant) mounted at a level approximating that of the cooling tower plume is a better predictor of plume direction than surface windsets (1.0 km from the plant) or 850 mb level winds. However, an apparent topographical influence on the wind direction measurements at the plume-level windset site somewhat limits its plume tracking capability, at least for ambient winds from the SW quadrant.

34129 (PNL-SA—7658) **Use of time averaged precipitation for wet removal in a regional air pollution assessment model.** Davis, W.E.; Eadie, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract AC06-76RL01830. 12p. (CONF-7910186—1). NTIS, PC A02/MF A01.

From 10. international technical meeting on air pollution modeling and its application; Rome, Italy (21 Oct 1979).

Results are presented of the test of a regional scale assessment model using four modes of precipitation hourly, 6 hourly, average turned on and off with the natural frequency and average precipitation. The test cases were carried out for a release of SO_2 with transformation to SO_4 at three different sites in the United States for July 1974. The results indicated that the use of average precipitation turned on and off with the natural frequency could be used instead of hourly precipitation for long-term assessments.

34130 (PNL-SA—8170) **Gas and aerosol scavenging.** Scott, B.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract AC06-76RL01830. 28p. (CONF-7911105—1). NTIS, PC A03/MF A01.

From Workshop on toxic substances in precipitation; Jekyll Island, GA, USA (13 Nov 1979).

The wet removal rate and wet deposition of pollutants is ultimately dependent upon the rate of pollutant attachment to the falling precipitation particles (hydrometeors) and to the precipitation flux at the ground. This attachment to the hydrometeors or collector particles is, in turn, dependent upon the physical characteristics of the pollutant. As expected, when considering wet removal, gases behave differently from aerosols. Modelers of gas scavenging (e.g., Hales 1972, Adamowitz 1979) stress the importance of drop size distribution, vertical gradients of gas concentration in the atmosphere and solubility in determining gas deposition at the surface. Aerosols, on the other hand, are removed at various rates depending upon aerosol size distribution, solubility, environmental humidity and age. Before the specifics of wet removal are dealt with, it is helpful to present some of the basic mathematical concepts used for treating problems in precipitation scavenging. By doing so, current terminology can be introduced and placed into a framework that should alleviate confusion about meaning. For example, a distinction between scavenging coefficients and simply scavenging will be made. The terminology in-cloud, below-cloud, washout, and rainout are shown to be ambiguous and will be dismissed. Other concepts, such as washout ratio, nucleation scavenging, vapor deposition versus accretion are shown to be more appropriate or useful when considering wet removal of aerosol and gas. Gas and aerosol removal are considered in general. For each, the emphasis is upon surface deposition, and upon properties that must be known to approximate wet surface fluxes. In the final section, the suspected properties of organics and metals are presented and related to wet removal.

34131 (PNL-SA—8431) **Hybrid regional air pollution models.** Drake, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 34p. (CONF-7910183—1). NTIS, PC A03/MF A01.

From Workshop on regional air pollution modeling; Port Deposit, MD, USA (29 Oct 1979).

This discussion deals with a family of air quality models for predicting and analyzing the fine particulate loading in the atmosphere, for assessing the extent and degree of visibility impairment, and for determining the potential of pollutants for increasing the acidity of soils and water. The major horizontal scales of interest are from 400km to 2000km; and the time scales may vary from several hours, to days, weeks, and a few months or years, depending on the EPA regulations being addressed. First the role air quality models play in the general family of atmospheric simulation models is described. Then, the characteristics of a well-designed, comprehensive air quality model are discussed. Following this, the specific objectives of this workshop are outlined, and their modeling implications are summarized. There are significant modeling differences produced by the choice of the coordinate system, whether it be the fixed Eulerian system, the moving Lagrangian system, or some hybrid of the two. These three systems are briefly discussed, and a list of hybrid models that are currently in use are given. Finally, the PNL regional transport model is outlined and a number of research needs are listed.

34132 (UCID—18771) **Treatment of dynamical processes in two-dimensional models of the troposphere and stratosphere.** Wuebbles, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1980. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01.

The physical structure of the troposphere and stratosphere is the result of an intricate interplay among a large number of radiative, chemical, and dynamical processes. Because it is not possible to model the global environment in the laboratory, theoretical models must be relied on, subject to observational verification, to simulate atmospheric processes. Of particular concern in recent years has been the modeling of those processes affecting the structure of ozone and other trace species in the stratosphere and troposphere. Zonally averaged two-dimensional models with spatial resolution in the vertical and meridional directions can provide a much more realistic representation of tracer transport than one-dimensional models, yet are capable of the detailed representation of chemical and radiative processes contained in the one-dimensional models. The purpose of this study is to describe and analyze existing approaches to representing global atmospheric transport processes in two-dimensional models and to discuss possible alternatives to these approaches. A general description of the processes controlling the transport of trace constituents in the troposphere and stratosphere is given.

34133 (UCRL—84339) **Long path optical extinction and meteorology in the San Francisco Bay Area.** Porch, W.M.; Galloway, T.R.; Green, T.J.; Waidl, J.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 13p. (CONF-801114—2). NTIS, PC A02/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

Instrumentation and analysis techniques aimed at establishing the relationships between remotely sensed meteorological and visibility parameters of the atmosphere are discussed. It is shown that long and short term visibility and atmospheric extinction trends are dominated by meteorological parameters. A report is made of new instrumentation and preliminary results using these instruments to remotely sense meteorological parameters along the same light path over which light extinction measurements are made. Those atmospheric parameters affecting visibility are water vapor, NO_2, ozone, aerosol, wind speed and stability or atmospheric temperature profile with height. All of these parameters can be remotely determined for a given light path by a combination of high resolution spectrographic absorption, low resolution wavelength extinction measurements optical scintillation and stellar refraction. Remotely sensed cross-path wind speeds are presently being determined from optical scintillation techniques and remote sensing of atmospheric mixing depths are being investigated using searchlight techniques or stellar refraction inversions. (JGB)

34134 (UCRL—84677) **Climate effects workshop.** Mitchell, J.M.; MacCracken, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1980. Contract W-7405-ENG-48. 21p. (CONF-8004110—1). NTIS, PC A02/MF A01.

From DOE research conference on CO/sub 2/; Washington, DC, USA (24 Apr 1980).

A summary of a workshop held to evaluate the climate section of the draft five year plan, A Comprehensive Plan for Carbon Dioxide Effects Research and Assessment, is presented. Issues discussed include climate modeling, past climates, scenario construction, and evidence of climate change. (ACR)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

34135 (CONF-8004111—1) **Stochastic model of radioiodine transport.** Schwarz, G.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From Radionuclide transport modeling workshop; Fort Collins, CO, USA (23 Apr 1980).

A research project has been underway at the Oak Ridge National Laboratory with the objective to evaluate dose assessment models and to determine the uncertainty associated with the model predictions. This has resulted in the application of methods to propagate uncertainties through models. Some techniques and results related to this problem are discussed.

34136 (DOE/EDP—0056) **Environmental development plan for special nuclear materials production.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Environment). Jul 1980. 39p. NTIS, PC A03/MF A01.

The scope of this Environmental Development Plan (EDP) follows the Special Nuclear Materials (SNM) Production category of the Department of Energy budget. It includes the process steps and facilities necessary for the production of plutonium and tritium for Government needs and the production of some other radioactive materials that will be used for heat and radiation sources by domestic and international customers. Most of the SNM production is now carried out at the Savannah River Plant, but plutonium is still produced at Hanford. This EDP does not address the mining, milling, or enrichment of the uranium, but it does consider the reactor fuel (and target) fabrication facilities. The production reactors and the spent fuel processing plants and their effluents are discussed here, but the defense wastes from them are treated in a separate EDP. The scope does not include transportation, decontamination and decommissioning, safeguards and security, or use of the SNM products.

34137 (LBL—11097) **Operating instructions for LBL radon measurement facilities.** Ingersoll, J.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 32p. (EEB-Vent—80-13). NTIS, PC A03/MF A01.

This manual is intended for users of the radon-measuring facilities of the Radon Project of the Building Ventilation and Indoor Air Quality Program at Lawrence Berkeley Laboratory. The manual comprises three parts. Part 1 sets out the steps involved in collecting, transferring, and counting radon. Part 2 describes the calibration of the transfer system and of the Lucas cells in the counting system. Part 3 outlines the maintenance procedures for the facility.

34138 (LBL—11192) **Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979.** Schleimer, G.E. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01.

Monitoring data obtained for the calendar year 1979 are described, and general trends are discussed. The following areas are covered: accelerator produced radiation; radionuclide measurements and release (atmospheric, water, and sewer sampling); population dose equivalent resulting from LBL operations; and nonradioactive pollutants. Over the past several years the atmospheric sampling program has, with the exception of occasional known releases, yielded data which are within the range of normal background. The surface water program always yields results within the range of normal background. As no substantial changes in the quantities of radionuclides used are anticipated, no changes are expected in these observations.

34139 (MLM—2758) **Radon monitoring program, February-April 1980.** Yates, W.G.; Hagee, G.R.; Jenkins, P.H. (Mound Facility, Miamisburg, OH (USA)). 21 Aug 1980. Contract AC04-76DP00053. 12p. NTIS, PC A02/MF A01.

The radon monitoring plan for Canonsburg, Pa., was implemented on 29 January 1980. Thirty-eight offsite locations were being monitored by the end of the quarter. Additional locations were planned to fulfill DOE Division of Environmental Control Technology requests. Overall distribution of the radon measurements has not yet been determined.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34128

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 33339

REGULATIONS

REFER ALSO TO CITATION(S) 33417

34140 (DOE/EIA—0201/12) **Energy policy study. Volume 12. Governmental actions affecting the environment and their effects on energy markets.** McCormick, C. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1980. 52p. NTIS, PC A04/MF A01.

The energy/environment tradeoff is described. The relationship between energy production and consumption and environmental pollution is discussed. Data are presented showing some of the pollutants which arise from the production and use of energy. The data indicate that the most severe problems with energy pollution are associated with coal production and consumption. A description is given of the major environmental laws which restrict energy production and uses to protect air, water, land, and life forms. Some of the laws described are: the Clean Air Act, the Federal Water Pollution Control Act, the Federal Coal Mine Health and Safety Act, the Surface Mining Control and Reclamation Act, the Solid Waste Disposal Act, and the Endangered Species Act. An overview of the energy/environment tradeoff is presented. The environmental laws are most likely to effect energy production and consumption activities which produce large quantities of pollutants or small quantities of toxic and hazardous pollutants. The sections of the environmental laws most likely to have greatest impact upon energy markets are: the new source performance standards, the prevention of significant deterioration requirements, the fossil fuel continuous cleaning requirements, and the motor vehicle emissions standards of the Clean Air Act, as amended; the effluent discharge standards of the Federal Water Pollution Control Act, as amended; the reclamation and land and water protection features of the Surface Mining Control and Reclamation Act; and the controls for toxic and hazardous substances of the Solid Waste Disposal Act, as amended. Also, as energy prices continue to rise and domestic oil and natural gas supplies continue to decline, the lands withdrawn from energy development will become increasingly valuable as potential sources of energy. Estimates of air and water pollution control costs for energy activities are presented.

34141 (LA-UR—80-1753) **Air quality regulation in spatial equilibrium models.** Kolstad, C.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 27p. (CONF-801015—1). NTIS, PC A03/MF A01.

From 5. international clean air congress; Buenos Aires, Argentina (20 Oct 1980).

A discussion is presented of methods for including a wide variety of air pollution regulations within the class of economic equilibrium models where allocation is based on constrained optimization. The first part of the paper discusses current air pollution regulation in the United States and possible future regulation. This is followed by the presentation of a prototype spatial equilibrium model within which a number of regulatory mechanisms are explicitly represented. These include efficient and zoned charges, statically and dynamically efficient permit systems, technological control and hybrid permit/charge systems.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 34111, 34148, 34149, 34180, 34182

34142 (BNL—51161) **1979 breeding bird censuses and summary of 1977-1979 results.** Raynor, G.S. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract AC02-76CH00016. 15p. NTIS, PC A02/MF A01.

As part of a program to characterize the plant and animal life of the Laboratory site and the surrounding region, the two breeding bird censuses originated in 1977 were continued in 1979. Twelve census trips were made to the BNL plot and 10 to the Westhampton plot by seven volunteer observers. Comparisons of data from the three years showed that the number of territorial males on the BNL plot did not change significantly, but the number of breeding species showed a continuous decline, from 18 to 10. Little change in the number of territorial males or in species composition occurred in the Westhampton plot.

34143 (CONF-8006101—1) **Methods for acquisition, storage, and evaluation of leguminous tree germplasm.** Felker, P. (California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences). 1980. Contract FG01-78ET20023. 10p. NTIS, PC A02/MF A01.

From Symposium on new and underutilized biological resources; Medellin, Colombia (6 Jun 1980).

Simple methods for establishing, maintaining, and planting of a small scale tree legume (Prosopis) germplasm collection by one or two people are described. Suggestions are included for: developing an understanding of the worldwide distribution of genus; becoming acquainted with basic and applied scientists working on the taxa; devising seed cleaning, fumigation, cataloging, and storage techniques; requesting seed from international seed collections; collecting seed from native populations; and for field designs for planting the germplasm collection.

34144 (DOE/EV/00641—34) **Arthropod use of invertebrate carrion.** Seastedt, T.R.; Mameli, L.; Gridley, K. (Georgia Univ., Athens (USA). Dept. of Entomology). 1 Aug 1980. Contract AS09-76EV00641. 17p. NTIS, PC A02/MF A01.

Arthropods associated with cricket carcasses placed on top and within deciduous forest litter were collected over a 12 month interval. Vespid wasps and ants quickly removed carcasses left on top of forest litter, but carcasses placed within litter persisted throughout the study. Major consumers of carcasses in litter varied seasonally; maggots dominated on fresh carcasses in summer, but fresh carcasses placed in litter in autumn were consumed by other arthropods. A gamasid mite, Hypoaspis (Laelaspis) johnieae dominated the microarthropod fauna found on exoskeleton fragments. A method for collecting invertebrate carrion feeders and measuring carrion disappearance is presented.

34145 (DOE/TIC—11249) **Verification, validation, and application of detailed forest succession models.** Shugart, H.H.; Doyle, T.W.; West, D.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01.

Model validation is often central to the development of useful models of any ecosystem. In a recent review, a category of ecological models called the gap models was identified as being particularly

useful in studies of long-term ecological succession. After briefly describing the mathematical structure of a gap model, we will discuss the techniques available for validation of these models and will provide examples of such tests. We will further discuss how these models might be used to predict the consequences of man-induced change on the long-term dynamics of forest ecosystems.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 34171

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34118

34146 (ANL/LRP-TM—18) **Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material.** Knight, M.J. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01.

Perchloric acid ($HClO_4$) is often used to destroy organic material contained in plant tissue during sample preparation for trace-element analysis. However, since perchloric acid is an extremely strong oxidizing agent that can cause fire and explosion when in contact with combustible materials, its use is best avoided when proper safety equipment and training is unavailable. A comparison was made of four digestion procedures that do not require perchloric acid: wet digestion with nitric and sulfuric acids; wet digestion with nitric acid alone; a repeated wet digestion with nitric acid; and direct dry ashing. Each procedure was used to digest National Bureau of Standards orchard leaves (SRM 1571). To investigate the effect of possible filter paper adsorption on the determination of trace elements, digested samples were either filtered or not filtered before analysis. Atomic absorption spectrophotometry was employed to determine concentrations of As, Be, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sr, and Zn in each digested sample. Recoveries of each element and the relative error of each determination for each digestion procedure were then calculated. A statistical analysis of these data indicates that the direct dry ashing procedure is best suited for multi-element analysis. Dry ashing is appropriate to recover As, Be, Cr, Cu, Fe, Mn, Mo, Pb, and Zn. The nitric-sulfuric acids, nitric acid, and repeated nitric acid digestion procedures were deemed poor for multi-element analysis; however, each proved useful for the recovery of certain individual elements, including Cd, Pb, and Zn. Sample filtration significantly ($p \leqq 0.05$) lowered the recovery of Cr, Mn, Pb, and Zn from the digested samples. Conversely, the recovery of As, Mo, and Sr was significantly ($p \leqq 0.05$) higher in samples filtered before analysis when compared to the recovery of these elements in unfiltered samples.

34147 (BM-IC—8827) **Minerals environmental in-house and contract research and development in fiscal year 1980.** (Bureau of Mines, Washington, DC (USA). Div. of Minerals Environmental Technology). 1980. 45p. Bureau of Mines, Pittsburgh, PA.

Research to identify and correct environmental problems associated with mining and metallurgical operations is outlined. Subprograms within research on environmental assessment are summarized initially. Research on new technology that can be used by the mining and mineral-processing industries for the prevention and/or control of adverse environmental impacts includes the following subprograms: reclamation; water management; alternative processes; surface stability; land use alternatives; waste management; subsidence; noise; vibration, and fugitive dust; and, mine closure. (JGB)

34148 (CONF-800350—) **Carbon Dioxide Effects Research and Assessment Program. The role of tropical forests on the world carbon cycle.** Brown, S.; Lugo, A.E.; Liegel, B. (eds.). (Florida Univ., Gainesville (USA). Center for Wetlands). Aug 1980. Contract AS05-78EV06047. 162p. NTIS, PC A08/MF A01.

From Conference on the role of tropical forests on the world carbon cycle; Rio Piedras, Puerto Rico (19 Mar 1980).

Tropical forests constitute about half of the world's forest and are characterized by rapid rates of organic matter turnover and high storages of organic matter. Tropical forests are considered to be one of the most significant terrestrial elements in the equation that balances the carbon cycle of the world. As discussed in the paper by Tosi, tropical and subtropical latitudes are more complex in terms of climate and vegetation composition than temperate and boreal latitudes. The implications of the complexity of the tropics and the disregard of this complexity by many scientists is made evident in the paper by Brown and Lugo which shows that biomass estimates for tropical ecosystems have been overestimated by at least 100%. The paper by Brown shows that that rates of succession in the tropics are extremely rapid in terms of the ability of moist and wet forests to accumulate organic matter. Yet, in arid tropical Life Zones succession is slow. This leads to the idea that the question of whether tropical forests are sinks or sources of carbon must be analyzed in relation to Life Zones and to intensities of human activity in these Zones. The paper by Lugo presents conceptual models to illustrate this point and the paper by Tosi shows how land uses in the tropics also correspond to Life Zone characteristics. The ultimate significance of land use to the question of the carbon balance in a large region is addressed in the paper by Detwiler and Hall.

34149 (DOE/EV/00641—37) **Mineral cycling in soil and litter arthropod food chains. Progress report, November 1, 1979-October 31, 1980.** Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). 1 Aug 1980. Contract AS09-76EV00641. 31p. NTIS, PC A03/MF A01.

Recent progress and current status are reported for research concerned with mineral element dynamics in soil arthropod food chains. Research is performed within the larger context of terrestrial decomposition systems, in which soil arthropods may act as regulators of nutrient dynamics during decomposition. Research is measuring rates of nutrient accumulation and excretion by using radioactive tracer techniques with radioactive analogs of nutrients. Experimental measurement of radioactive tracer excretion and nutrient element pools are reported for soil microarthropods, using new methods of counting and microprobe elemental analysis. Research on arthropod-fungal relations is utilizing high-efficiency extraction followed by dissection of 13 x 13 cm soil blocks. A two-component excretion model is reported for Cobalt-60 in earthworms (Eisenia foetida), demonstrating that no assimilation of cobalt occurs from the mineral soil fraction but is entirely from organic matter. Collection of data sets on soil arthropod communities and abundances is completed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34138

SOIL

REFER ALSO TO CITATION(S) 33300, 33319, 33332, 33338, 34153

34150 (DOE/DP/04515—1) **Redox reactions involving chromium, plutonium, and manganese in soils.** Amacher, M.C.; Baker, D.E. (Pennsylvania State Univ., University Park (USA)). 1979. Contract AS02-77DP04515. 14p. NTIS, PC A02/MF A01.

Plutonium speciation in soils is discussed. Chromium was selected as a model for studying soil Pu. Similarities between Cr and Pu are pointed out, and a hypotheses concerning Pu speciation in soils is presented. Findings from Cr oxidation studies that may be relevant to the problem of Pu oxidation in soils are discussed. (JGB)

34151 (ORNL—5465) **Radiological survey of the radioactive sands and residues at Lowman, Idaho.** Haywood, F.F.; Burden, J.E.; Ellis, B.S.; Loy, E.T.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 68p. NTIS, PC A04/MF A01.

No uranium ore milling was performed at the Lowman site, which is located approximately 0.8 km northeast of the town of Lowman, Idaho. Nevertheless, approximately 80,000 metric tons of radioactive sands and residues from upgrading of heavy minerals by physical processing methods remain on the site grounds. Measurements of external gamma radiation 1 m above the surface showed exposure rates up to 2.4 mR/hr on site, but the exposure rate off site quickly dropped to the background level in all directions. Analysis of surface soil and sediment samples for ^{226}Ra and ^{232}Th indicated a limited spread of radioactive material.

34152 (DOE/EV/04700—T1) **Adsorption and diffusion of plutonium in soil.** Brown, D.A. (Arkansas Univ., Fayetteville (USA). Dept. of Agronomy). [nd]. Contract AS05-76EV04700. 9p. NTIS, PC A02/MF A01.

The behavior of plutonium (Pu) was studied in three soils that varied in texture, CEC, pH, organic matter content and mineralogy (Fuquay, Muscatine, Burbank). Two isotopes, ^{238}Pu and ^{239}Pu, were used in order to detect Pu over a range of several orders of magnitude. Unless added in a chelated form, Pu was added to the soil as a nitrate in .01 N HNO_3 to simulate the release of acidic waste on the soil and to prevent rapid Pu hydrolysis or polymerization.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 34135, 34136

34153 (UCRL—52966) **Evaluation of oxidation techniques for preparing bioassay and environmental samples for liquid scintillation counting.** Miller, H.H. (California Univ., Livermore (USA). Law-

rence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

In environmental and biological monitoring for carbon-14 and tritium, the presence of color and chemical quenching agents in the samples can degrade the efficiency of liquid scintillation counting. A series of experiments was performed to evaluate the usefulness, under routine conditions, of first oxidizing the samples to improve the counting by removing the color and quenching agents. The scintillation counter was calibrated for the effects of quenching agents on its counting efficiency. Oxidizing apparatus was tested for its ability to accurately recover the ^{14}C and ^{3}H in the samples. Scintillation counting efficiences were compared for a variety of oxidized and unoxidized environmental and bioassay samples. The overall conclusion was that, for routine counting, oxidation of such samples is advantageous when they are highly quenched or in solid form.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 33225, 33326, 33327, 33330, 33331, 33333, 33338, 33691, 33730, 33800, 34223

34154 (DP—1525) **Locations and areas of ponds and Carolina Bays at the Savannah River Plant.** Shields, J.D.; Woody, N.D.; Dicks, A.S.; Hollod, G.J.; Schalles, J.; Leversee, G.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jun 1980. Contract AC09-76SR00001. 22p. NTIS, PC A02/MF A01.

The Savannah River Plant has 28 ponds and 189 Carolina Bays on its 192,000-acre site. Excluding the Par Pond system, the mean pond ares is 17.6 acres, with a range of 0.4 to 202.8 acres. Par Pond is the largest pond, with an area of 2500 acres. The mean Carolina Bay area is 6.6 acres, with a range of less than 0.3 to 124.0 acres. The geographical location of each pond and bay has been digitized and can be graphically displayed by computer. This capability will facilitate identification of wetland areas as required by Executive Order 11990 (Protection of Wetlands, May 24, 1977).

34155 **Siting energy related facilities in Louisiana's coastal zone.** Baton Rouge, LA; Louisiana Dept. of Transportation and Development (1978). 57p. (NP—25058).

The objective of this booklet is to present siting procedures for energy facilities in the coastal area that meet state and federal requirements, incorporate concepts of impact assessment, which are useful to professionals in planning and design of facilities, and that are easily understood by people at the local decision making level. The focus is on siting procedures as a part of Louisiana's overall planning process for energy facilities. The state's coastal zone program will include further articulation of its policies for managing energy facilities and their impacts, identification of how interested and affected groups may be involved, means for consideration of the national interest, and identification of legal authorities and management techniques to implement state policies and procedures. The procedure outlined requires the expertise and participation of a broad spectrum of professionals, agency personnel, and public officials. Engineers, environmental scientists, attorneys, economists, planners, the public and elected officials will all be involved at various stages. There is, therefore, a need for coordination of activities over time at many levels of government, and across several geographical jurisdictions. The lead consultant or agency for development of a particular project will be responsible for coordination of the various aspects of facility siting and design throughout the procedure outlined herein. This booklet provides the overview necessary to insure that projects are considered on a comprehensive basis and meet environmental and coordination requirements presently in force. It is flexible enough that as needs and requirements change, new concerns may be easily integrated into the overall structure of facility, environment, and institutional areas that form the conceptual basis for any siting activity.

REGULATIONS

REFER ALSO TO CITATION(S) 33274, 34140

ENVIRONMENTAL SCIENCES, AQUATIC

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 34111, 34163

34156 (BNL—28136) **Collection, purification, and culture of cyanobacteria.** Court, G.J.; Kycia, J.H.; Siegelman, H.W. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 18p. (CONF-8006110—1). NTIS, PC A02/MF A01.

From 1. international symposium on toxic blue-green algae; Dayton, OH, USA (29 Jun 1980).

Detailed studies of the structure, physiology, biochemistry, and toxin production of cyanobacteria require a dependable and reproducible supply of selected organisms. Axenic cloned strains of cyanobacteria should be used whenever possible. Several physical and chemical techniques are available to purify cultures to the axenic condition. Cultural techniques are described here which can be used to grow adequate amounts, greater than 100 g fresh weight, of cyanobacteria in about four weeks.

34157 (COO—1340-68(Draft)) **Cross-spectral study of the spatial relationships in the North Pacific sea-surface temperature anomaly field. Report No. 23.** Middleton, J.W. (Colorado State Univ., Fort Collins (USA)). Mar 1980. Contract AC02-76EV01340. 120p. NTIS, PC A06/MF A01.

Cross-spectral analysis is used to examine the dependence of the temporal covariation of sea-surface temperature (SST) anomalies at pairs of spatially separated points in the North Pacific on (1) the time scale of the variations, (2) the relative displacement of the points and (3) their location within the North Pacific basin. Spatial scales considered here range from 1000 kilometers up to the width of the basin. The study focuses on cross-spectral estimates for the interannual frequency band, 0.125-0.75 yr^{-1} although estimates for three other bands spanning higher frequencies are also examined.

34158 (ORNL/TM—7127) **Biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978.** Schaich, B.A.; Coutant, C.C. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 225p. NTIS, PC A10/MF A01.

Thesis. Submitted by B.A. Schaich to Univ. of Tennessee, Knoxville.

Habitat selection of 31 adult striped bass was monitored by temperature sensing ultrasonic and radio transmitters in Cherokee Reservoir, Tennessee, from March through October 1978. This study sought to corroborate summer data obtained by Waddle (1979) in 1977 and to examine mechanisms of habitat selection by observing establishment of the summer distribution. During the spring and early summer months the striped bass ranged throughout the study area in the downstream half of the reservoir. Fish stayed near the bottom at the preferred temperatures throughout the whole study, and no individuals were observed in open water. Movement rates of up to 2.6 km/day were estimated, and rates of 1 km/day were common in the spring. By late July they were apparently avoiding low dissolved oxygen (D.O.) concentrations (<3 mg/l) near the bottom of the main reservoir and epilimnion temperatures greater than 22°C, and they moved into cool, oxygenated spring or creek channels (refuges). Low movement rates of 0 to 25 m/day within these refuges occurred. The rates of the few migrations between refuges could not be estimated. Tagged fish moved out of the refuges 3 to 4 weeks after the fall overturn when reservoir temperatures approximated 22 to 24°C.

34159 **Inputs for risk analysis in water systems.** McBean, E.A.; Hipel, K.W.; Unny, T.E. (eds.). Fort Collins, CO; Water Resources Publication (1979). 488p. (CONF-7806188—(Vol.1)). Water Resources Application, P.O. Box 2841, Littleton, CO.

From International symposium on risk and reliability in water resources; Waterloo, Ontario, Canada (26 Jun 1978).

This book is the first of two volumes that present the proceedings of the International Symposium on Risk and Reliability in Water Resources. The twenty-five research papers are categorized according to the following four subdivisions: extreme value distributions; analysis of floods; time series models; data collection, and analysis. In each category new developments are presented both from a theoretical and practical point of view. (JGB)

34160 **Reliability in water resources management.** McBean, E.A.; Hipel, K.W.; Unny, T.E. (eds.). Fort Collins, CO; Water Resources Publication (1979). 413p. (CONF-7806188—(Vol.2)). Water Resources Application, P.O. Box 2841, Littleton, CO.

From International symposium on risk and reliability in water resources; Waterloo, Ontario, Canada (26 Jun 1978).

This book is the second of two volumes that present the proceedings of the International Symposium on Risk and Reliability in Water Resources. The twenty-one research papers are categorized

according to the following three subdivisions: socio-economic and decision theory considerations; reservoir design and operation; reliability concepts in practical water management. Within each category new developments are presented both from a theoretical and practical point of view. (JGB)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33226, 33271, 34118

34161 (BNL—28123) **Sulfuric acid spills in marine accidents.** Tang, I.N.; Wong, W.T.; Munkelwitz, H.R.; Flessner, M.F. (Brookhaven National Lab., Upton, NY (USA); Department of Transportation, Washington, DC (USA)). Jul 1980. Contract AC02-76CH00016. 19p. (CONF-801025—1). NTIS, PC A02/MF A01.

From 6. international symposium on transport of dangerous goods by sea and inland waterways; Tokyo, Japan (13 Oct 1980).

Concentrated sulfuric acid and oleum are among the most potentially hazardous chemicals routinely transported in bulk quantities on US and international waterways. Conceivably, during a marine mishap, tons of sulfuric acid could be abruptly released into the water, and the consequences of such a spill could be detrimental to man and the environment. Several acid spill scenarios are briefly described, and the results from laboratory experiments designed to simulate two different types of acid spill accidents are reported. It is shown that the convective mixing of concentrated sulfuric acid with water can adequately be described by a mathematical model which takes into account the variation of the buoyancy force arising from changes in acid concentration and released heat of dilution. A value of 0.21 is determined to be the entrainment parameter for the mixing of sulfuric acid with water. For oleum spills in which acid aerosol formation is a potential safety hazard, a conservative estimate of less than one-tenth of a percent is obtained for the amount of airborne acid under most accident conditions. The fraction of airborne acid, however, decreases very rapidly with increasing release depth below water surfaces. The acid aerosols exhibit a well-defined log-normal particle-size distribution with peak diameter varying from 0.1 to 0.6 μm (at 70% R.H.) depending upon release depth. This is well within the respirable particle size range.

34162 (BNL—28173) **Acid precipitation and the aquatic environment.** Hendrey, G.R.; Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). 28 May 1980. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01.

A review is presented of the problem of acid rain in the eastern United States. The historical development of acid rain, its causes and the mechanisms of its formation, and its impact on aquatic ecosystems are discussed. (ACR)

34163 (BNL—51211) **Energy-related perturbations of the northeast coastal zone: five years (1974-1979) of oceanographic research at Brookhaven National Laboratory.** Walsh, J.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 28p. NTIS, PC A03/MF A01.

Since inception of oceanographic research at Brookhaven National Laboratory in 1974, over 75 cruises and 150 papers and reports have been completed. In comparison of shelf ecosystems at high, mid, and low latitudes, an understanding of the natural variability of US coastal waters has been derived. Annual carbon and nitrogen budgets suggest that the energy flow is diverted to a pelagic food web in summer-fall and a demersal food web in winter-spring within the Mid-Atlantic Bight. The impact of energy-related perturbations can now be assessed within the context of natural oscillation of the coastal food web.

34164 (CONF-790382—(Absts.)) **Abstracts from a workshop on processes determining the input, behavior and fate of radionuclides and trace elements in continental shelf environments.** (Department of Energy, Washington, DC (USA). Div. of Ecological Research). Mar 1980. 200p. NTIS, PC A09/MF A01.

From Radionuclide/trace element cycling workshop; Gaithersburg, MD, USA (7 Mar 1979).

Abstracts of workshop presentations concerning input, behavior, and fate of trace metals and radionuclides in the marine system are presented. (ACR)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34138

WATER

REFER ALSO TO CITATION(S) 33300, 34153

34165 (GJBX—161(80)) **Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13-76GJ01664. 88p. (DPST—79-146-20). NTIS, PC A05/MF A01.

This data report presents results of groundwater and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Pocatello 1° x 2° quadrangle. Surface samples (sediment) were collected from 1701 sites. The target sampling density was one site per 16 square kilometers (six square miles). Ground water samples were collected at 381 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Data from sediment sites include: (1) stream water chemistry measurements where applicable (pH, conductivity, and alkalinity); and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, and U/La ratios; and scintillometer readings for sediment sample sites are included on the microfiche. Data from groundwater sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description, and scintillometer reading); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from stream water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); and (2) elemental analyses (U, Al, Br, Cl, F, Mg, Mn, Na, and V).

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 34136, 34151, 34153, 34164

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 33334, 33335, 34155

REGULATIONS

REFER ALSO TO CITATION(S) 33336, 34140

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 33678

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 33669, 33670

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 33677, 33679

34166 (CONF-800819—2) **Simulation approach to a regional resource environment conflict.** Krummel, J.R.; Klopatek, J.M.; Mankin, J.B.; O'Neill, R.V. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From Summer computer simulation conference; Seattle, WA, USA (25 Aug 1980).

Present environmental legislation has forced government agencies to assess the full impact of their projects and provide citizens a forum to express their opinions on any proposed actions. This assumes, however, the existence of a rational planning and evaluation process, supported by adequate knowledge and information of the impacts under study. While site-specific analyses have received much attention, regional environmental analysis has often proceeded on an ad hoc basis. The lack of a basic design for regional environmental analysis has hindered the development of an integrative approach to large-scale problems. The development of a theoretical framework which provides the minimal description of system dynamics, sufficient to address conflicts at the regional scale, repre-

sents a basic challenge for regional analysis. In this paper we suggest such a framework in the form of a minimal set of state descriptors. We also examine a regional problem, presented as a heuristic device, to test whether the proposed framework is sufficient to address the dynamics of regional conflicts.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 33284

BIOMEDICAL SCIENCES, BASIC STUDIES

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 34156, 34174

34167 (BNL—28030) **Picosecond electron transfer in diporphyrin models of Photosystem II of green plants.** Netzel, T.L.; Fujita, I.; Wang, C.B.; Fajer, J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-800827—3). NTIS, PC A02/MF A01.

From 3. international conference on photochemical conversion and storage of solar energy; Golden, CO, USA (3 Aug 1980).

Green plants and photosynthetic bacteria efficiently transform the energy of an absorbed photon into redox products. Current in vivo and in vitro studies on Photosystem II (PS II) suggest the electron donor is a chlorophyll monomer, ligated to produce the high oxidation potential of P680, and the electron acceptor is pheophytin, a metal-free chlorophyll. This study probes the behavior of this PS II model in solvents of high dielectric constant and tests the sensitivity of its charge transfer reactions to increases in linking chain length as well as to changes in the relative orientation of the porphyrin subunits. (ACR)

34168 (DOE/EV/03083—T1) **Comprehensive progress report, 1977-1980.** Suyama, Y. (Pennsylvania Univ., Philadelphia (USA). Dept. of Biology). 1980. Contract AS02-76EV03083. 11p. NTIS, PC A02/MF A01.

Research accomplishments and activities during the past three year period are described. Specific projects were: (1) restriction endonuclease studies of tetrahymena mtDNA; (2) biosynthesis of mitochondrial tRNA; and (3) structure and synthesis of tRNA charging enzymes. (ACR)

34169 (DOE/EV/02814—1) **Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report.** Grossman, L. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Biochemistry). [nd]. Contract AC02-76EV02814. 6p. NTIS, PC A02/MF A01.

Research progress is reported in the purification of human placental DNA repair enzymes and the determination of their properties. (ACR)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 34179

GENETICS

34170 (COO—1300-45) **Organization of the R chromosome region in maize.** (Wisconsin Univ., Madison (USA)). Dec 1979. Contract AS02-76EV01300. 10p. NTIS, PC A02/MF A01.

Research is reported which seeks to analyze variations in anthocyanin pigmentation in maize attributable to the R region on chromosome 10. The emphasis is on the structure of the individual genic elements. (ACR)

METABOLISM

REFER ALSO TO CITATION(S) 34174

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 34179

34171 (DOE/EV/00641—38) **Improved methods for measuring radioactive tracer accumulation and excretion by microarthropods, with applications for a mite species, Tyrophagus longior (Acarina, Acaridae).** Abbott, D.T.; Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). 1 Aug 1980. Contract AS09-76EV00641. 16p. NTIS, PC A02/MF A01.

Radioisotope retention measurements of ^{85}Sr and ^{51}Cr in Tyrophagus longior (Gervais) (Acari: Acaridae) were fit to 2 and 1 component models. Biological half-life for the rapid component of both radioisotopes was about 10 hours, with assimilation of ^{85}Sr being 62%. The identification of ^{51}Cr turnover as gut clearance must remain tentative. An inexpensive disposable culture chamber for measuring radioisotope retention in microarthropods is described along with details of methodology.

MEDICINE

REFER ALSO TO CITATION(S) 33969

34172 (COO—3077-163) **Ethical procedures in comparative evaluation of drugs.** Percus, O.E.; Percus, J.K. (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). Feb 1980. Contract AC02-76ER03077. 45p. NTIS, PC A03/MF A01.

The comparison of sampled distributions is one of the classical problems of statistics. Evaluation of any technique for doing so depends at least implicitly on an assumed cost function. In one of the most important applications, that of choosing treatments for the ailments of man, costs are measured in suffering and death, and must be accorded primary importance. A highly simplified but in fact prototypical situation of this kind is addressed, in which two drugs, A and B, are available for a specified illness, their actions are unequivocal or dichotomic: success or failure, and this action is on a time scale short compared to that on which patients receiving the drugs present themselves. The assumption is that the mode of treatment with each drug is sufficiently stylized that each drug can be fully represented for each patient independently by success probability p. The problem then is to design a sequential selection of treatments so that the drug with the higher success probability is used as often as possible.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

34173 (DOE/EV/10343—4) **Quality control of software in dissimilar systems using a common clinical data base.** Erickson, J.J.; Price, R.R.; Touya, J.J.; Kronenberg, M.W.; Pederson, R.; Rollo, F.D. (Vanderbilt Univ., Nashville, TN (USA). Medical Center). 1980. Contract AS05-80EV10343. 9p. (CONF-800937—2). NTIS, PC A02/MF A01.

From International symposium on medical radionuclide imaging; Heidelburg, F.R. Germany (1 Sep 1980).

For a long time there has been widespread interest in the quality control of diagnostic instrumentation. The increasing dependence on computational systems for clinical results makes it imperative that methods for quality control of diagnostic software be developed. This paper proposes a method based on the use of a collection of patient studies for which the results have been corroborated by independent methods. The data set will be distributed in a format requiring no special handling by the system being tested and will appear identical to studies actually collected by the host system. An example of the use of a preliminary version of the data set for comparison of two systems is shown. The comparison shows that analyses performed on the two systems agree very well and can be reliably compared for follow-up studies of a patient.

34174 (FMI—45) **Annual report 1978 and final report 1979.** Lanzl, E.F. (ed.). (Franklin McLean Memorial Research Inst., Chicago, IL (USA)). 1979. Contract AC02-76EV00069. 71p. NTIS, PC A04/MF A01.

Research projects conducted during 1978 in the fields of cytology, biochemistry, immunology, and nuclear medicine are reported. (ACR)

34175 (UCLA—12-1257) **Cardiovascular nuclear medicine 1980.** Schelbert, H.R.; Kuhl, D.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1980. Contract AM03-76SF00012. 8p. (CONF-800933—1). NTIS, PC A02/MF A01.

From 18. international annual meeting of the Society of Nuclear Medicine; Nurnberg, F.R. Germany (9 Sep 1980).

An overview is presented of the history, development, state-of-the-art, and future trends of cardiovascular nuclear medicine. (ACR)

34176 (UCLA—12-1258) **Positron computed tomography: current state, clinical results and future trends.** Schelbert, H.R.; Phelps, M.E.; Kuhl, D.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology; California Univ., Los

Angeles (USA). School of Medicine). 1980. Contract AM03-76SF00012. 8p. (CONF-800933—2). NTIS, PC A02/MF A01.

From 18. international annual meeting of the Society of Nuclear Medicine; Nurnberg, F.R. Germany (9 Sep 1980).

An overview is presented of positron computed tomography: its advantages over single photon emission tomography, its use in metabolic studies of the heart and chemical investigation of the brain, and future trends. (ACR)

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 34185

34177 (LBL—9892) **Advances in diagnostic instrumentation.** Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

Developments in medical imaging in the last ten years are described. Techniques include fine focus x-ray tubes, computerized tomography, emission tomography, and ultrasonography. (ACR)

MICROBIOLOGY

REFER ALSO TO CITATION(S) 33315, 33324

MORPHOLOGY

REFER ALSO TO CITATION(S) 34156

PATHOLOGY

34178 (UCLA—12-1261) **Cell culture systems to study glial transformation.** Bressler, J.P.; Cole, R.; de Vellis, J. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1980. Contract AC03-76SF00012. 8p. (CONF-800742—2). NTIS, PC A02/MF A01.

From 2. international congress on toxicology; Brussels, Belgium (6 Jul 1980).

The transformation of two different types of glial cells has been studied using an in vivo-/in vitro model and a complete in vitro model. The purpose of the study and to define in vitro model systems is to study the the neoplastic transformation of pure populations of glial cells. Data are presented to demonstrate that the transformed cells are glial and tumorigenic. (ACR)

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 34156

TRACER TECHNIQUES

34179 **Seasonal changes in within-canopy allocation of ^{14}C-photosynthate by white oak.** McLaughlin, S.B.; McConathy, R.K.; Beste, B. Contract W-7405-ENG-26. *For. Sci.;* **25**: No. 2, 361-370(Jun 1979).

Seasonal changes in photosynthate translocation and allocation of two mature, co-dominant white oak trees were studied by following rates of movement of ^{14}C-photosynthate from foliage labeled with $^{14}CO_2$. Loss rates were determined by sampling foliage at 5 min and 1, 4, and 7 days after labeling on each of five dates (April 22-October 4). Incorporation of ^{14}C-photosynthate into 1-, 3-, and 5-year-old branches was determined 7 days after tagging. Losses of ^{14}C from leaves were rapid by day 1 ($\leq$ 80%), greatly reduced by day 4, and ranged from 63 to 91% by day 7. Maximum retention of initial activity levels occurred in April for leaves (44%) and in October for branches (15%). Approximately equal apportionment of activity between leaves and branches did not occur until August. Highest total retention of photosynthate in the canopy occurred in April (due to high incorporation in leaves) and June (due to high retention in both leaves and branches). Based on measured retention and estimated respiration losses, translocation of the original ^{14}C-photosynthate from the canopy was calculated to be approximately 0% in April, 30% in June, and 60% in October. These results indicate that canopy growth and maintenance impose a significant drain on availability of photosynthate throughout the growing season.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 33791, 34143

34180 (CONF-8004108—1) **Nitrogen cycling: water use efficiency interactions in semi-arid ecosystems in relation to management of tree legumes (Prosopis).** Felker, P.; Clark, P.R.; Osborn, J.; Cannell, G.H. (California Univ., Riverside (USA)). Apr 1980. Contract FG01-78ET20023. 32p. NTIS, PC A03/MF A01.

From International symposium on browse in Africa; Addis Abba, Ethiopia (Apr 1980).

Plant productivity in semi-arid ecosystems is often limited by soil fertility as much as it is by moisture availability. A quantitative assessment of nitrogen limitations on water use efficiency has been made after careful review of plant water use efficiency data at high and low soil fertilities and after careful review of nitrogen inputs to semi arid ecosystems in the form of: blue-green algae-lichen crusts; non-symbiotic nitrogen fixers; rainfall; and tree legumes. This analysis indicates that plant productivity in semi-arid regions may be 10 fold more limited by nitrogen than moisture availability. Forage yields of non-nitrogen fixing trees and shrubs could be greatly increased by interplanting with drought adapted nitrogen fixers such as Prosopis and Acacia. Calculations based on water use efficiencies of annual legumes and nitrogen fixation values of tree legumes predict that well managed, spaced, and cared for orchards of specially selected Prosopis could produce 4000 $Kgha^{-1}\,yr^{-1}$ of 13% protein pods at 500 mm annual rainfall with only light fertilization with phosphate, potassium and sulfur. Field measurements of pod yields for 25 selections of 3 year old Prosopis grown under managed orchard conditions in southern California are presented. Spacing regimes and harvesting techniques for Prosopis are proposed to facilitate pod production.

34181 (DOE/EV/00637—9) **Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Annual progress report, November 1, 1979 to October 31, 1980.** Burton, G.W.; Hanna, W.W. (Georgia Univ., Athens (USA). Research Foundation). 1980. Contract AS09-76EV00637. 46p. NTIS, PC A03/MF A01.

New techniques are described for using irradiation and chemical mutagens in the genetic improvement of several warm season grasses. Genetic and cytogenetic effects of these treatments are also being studied. (ACR)

34182 (DOE/EV/00641—41) **Comparison of soil surface arthropod populations in conventional tillage, no-tillage and old field systems.** Blumberg, A.Y.; Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). 1 Aug 1980. Contract AS09-76EV00641. 31p. NTIS, PC A03/MF A01.

Soil surface arthropod populations in conventional tillage (CT) and no-tillage (NT) sorghum and adjacent old field (OF) were compared using pitfall trap captures. Total numbers of individuals and species, overall diversity (anti H), richness (D), evenness (J'), dominance (C) and similarity quotients (QS) between systems were calculated for each of seven 24 hour sampling periods throughout the season. Although each system was distinct (any two of the systems had less than 30 percent of their species in common), NT was most similar to OF and least similar to CT during a period of stress (drought) and after heading of the sorghum. Percentages of individuals and species represented by spiders were similar in NT and OF; percentages were substantially less in CT. Yields (biomass of sorghum) in CT and NT were not significantly different despite the generally predicted higher pest populations in NT. Results suggest that insecticide stress may lower the stability of NT systems, thus allowing an increase in pest species.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 34179

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

34183 (UR—3490-1878) **Brief description of research papers accepted for publication during 1979. Annual report.** Nash, D.B. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 16 Jun 1980. Contract AC02-76EV03490. 95p. NTIS, PC A05/MF A01.

Brief descriptions of research papers in radiobiology, biochemistry, metabolism, and biophysics published during 1979 are presented. The research was conducted by investigators in the Dept. of Radiation Biology and Biophysics. (ACR)

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

34184 (DOE/EV/03221—68) **Distinction between the roles of O_2 and of O^-_2 in biological radiodamage.** Samuni, A.; Chevion, M.; Halpern, Y.S.; Ilan, Y.A.; Czapski, G. (Hebrew Univ., Jerusalem (Israel)). 1978. Contract AC02-76EV03221. 2p. (CONF-781249—1). NTIS, PC A02/MF A01.

From Joint annual meeting of the Israel Nuclear Societies Ben Gurion University of the Negev; Beersheba, Israel (28 Dec 1978).

The paper attempts to elucidate the roles of oxygen and superoxide radical in biological damage due to ionizing radiation. Specifically, the effect of gamma radiation on the survival of T4 bacteriophage and of E. coli B has been investigated. (ACR)

BASIC STUDIES

REFER ALSO TO CITATION(S) 33324

APPLICATIONS

REFER ALSO TO CITATION(S) 34181

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 33340

34185 (CONF-791103—81) **Estimating the risk associated with computerized tomography doses.** Yalcintas, M.G.; Leggett, R.W.; Dunning, D.E.; Nalcioglu, O. (Oak Ridge National Lab., TN (USA); California Univ., Irvine (USA). Dept. of Radiological Sciences). 1979. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The largest annual whole- body dose to the US population from man-made radiation is from medical sources. According to the BEIR report, the use of diagnostic x-rays by the medical profession has increased in recent years at an annual rate of 1 to 4%. Risk factors developed by the BEIR committee can be used to estimate the risk to the population due to the exposure incurred through medical radiography. In this paper, these risk factors are employed to obtain an estimate of risk due to radiation exposure from computerized tomography (CT).

34186 (EML—380) **Radiation carcinogenesis in man. A critical review.** Woodard, H.Q. (Department of Energy, New York (USA). Environmental Measurements Lab.). Aug 1980. 134p. NTIS, PC A07/MF A01.

The review examines such reports as are available in which there is reasonable evidence that human cancer has been caused by ionizing radiation. The reported incidence of cancer of each type is correlated with such factors as seem pertinent and for which data have been recorded. Many factors are interrelated and can not be considered separately, but major emphasis is given to radiation quantity. This includes both a consideration of the dose/response relation where there is good evidence that cancer has been caused by radiation and a consideration of situations where the evidence for carcinogenesis by very small radiation doses is doubtful. (ACR)

34187 (PNL-SA—8106) **Continuing study of mortality in Hanford workers.** Marks, S.; Gilbert, E.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract AC06-76RL01830. 12p. (CONF-791085—7). NTIS, PC A02/MF A01.

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The mortality of workers at the Hanford Plant in southeastern Washington who have been exposed to penetrating external ionizing radiation is studied. Deaths are analyzed statistically and compared to standardized mortality ratios. Cancer deaths in particular are examined. (ACR)

34188 (PNL-SA—8110) **Mortality of Hanford radiation workers.** Gilbert, E.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 13p. NTIS, PC A02/MF A01.

The effects of occupational exposure to low level ionizing radiation at the Hanford plant in southeastern Washington were investigated. Death rates were related to exposure status. To provide perspective, the rates were also compared with the death rates of the US population. (ACR)

VERTEBRATES

REFER ALSO TO CITATION(S) 34228

34189 (AD-A—076768) **Effect of microwaves on the immune system. Technical report.** Sulek, K.; Wiktor-Jedrzejczak, W.; Smith, A.H.; Calcagno, P.L. (Georgetown Univ., Washington, DC (USA). Lombardi Cancer Center). 15 Sep 1979. Contract N00014-78-C-0278. 10p. NTIS, PC A02/MF A01.

The threshold level of absorbed energy required to trigger the inductive events was determined. It was found that a minimum of a single 15 minute exposure (0.6 W, 11.8 W/kg, 10.6 J/g) or a single 30 minute exposure (0.3 W, 5.0 W/kg, 9.07 J/g) induced a significant increase of CR+ cells on day three which peaked on day six. It was also found that once the critical threshold level of absorbed energy was obtained, the induced response was maximum. In evaluating the effect of subthreshold doses it was found that the absorption of multiple subthreshold quantities of microwave energies was cumulative, inducing an increase in CR+ cells, providing the exposures occurred within one hour of one another.

34190 (ORNL/CSD/TM—68) **Some properties of the log-Laplace distribution.** Uppuluri, V.R.R. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

A random variable γ is said to have the Laplace distribution or the double exponential distribution whenever its probability density function is given by $\lambda \exp(-\lambda \text{ absolute value } (y))$, where $-\infty < y < \infty$ and $\lambda > 0$. The random variable $X = \exp(\gamma)$ is said to have the log-Laplace distribution. With the problem of extrapolation to low doses in dose response curves as a motivation, an axiomatic characterization of the log-Laplace distribution is obtained. 1 figure.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

34191 (DOE/EV/10303—5) **CAMIRD III: Computer Assisted Medical Internal Radiation Dosimetry. FORTRAN IV version.** Bellina, C.R.; Guzzardi, R. (Vanderbilt Univ., Nashville, TN (USA). Medical Center). 1980. Contract AS05-80EV10343. 116p. NTIS, PC A06/MF A01.

This paper desribes the FORTRAN IV version of the P.A. Feller's CAMIRD/II Package (1) revised. In addition another FORTRAN IV program named TILDY (2), which determines the cumulated activity, has been revised and modified to be used as a subroutine of CAMIRD's main program. With such an organization all the calculation involved in dose computation becomes easier and quicker.

34192 (PNL-SA—8291) **Estimating population health risk from low-level environmental radon.** Fisher, D.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 4p. (CONF-800398—1). NTIS, PC A02/MF A01.

From Specialist meeting on assessment of radon and daughter exposure and related biological effects; Rome, Italy (3 Mar 1980).

Although incidence of respiratory cancer is directly related to inhalation of radon and radon daughters, the magnitude of the actual risk is uncertain for members of the general population exposed for long periods to low-level concentrations. Currently, any such estimate of the risk must rely on data obtained through previous studies of underground-miner populations. Several methods of risk analysis have resulted from these studies. Since the breathing atmospheres, smoking patterns, and physiology are different between miners and the general public, overestimates of lung cancer risk to the latter may have resulted. Strong evidence exists to support the theory of synergistic action between alpha radiation and other agents, and therefore a modified relative risk model was developed to predict lung cancer risks to the general public. The model considers latent period, observation period, age dependency, and inherent risks from smoking or geographical location. A test of the model showed excellent agreement with results of the study of Czechoslovakian uranium miners, for which the necessary time factors were available. The risk model was also used to predict lung cancer incidence among residents of homes on reclaimed Florida phosphate lands, and results of this analysis indicate that over the space of many years, the increased incidence of lung cancer due to elevated radon levels may be indisgtinguishable from those due to other causes.

34193 (DOE/EV/10343—6) **ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides.** Hirayama, A.; Kishimoto, Y.; Shinohara, K. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works; Vanderbilt Univ., Nashville, TN (USA). Medical Center). 1980. Translation of PNCT841-78-01. 72p. NTIS, PC A04/MF A01.

ACRO was developed as a computer program to calculate internal exposure doses resulting from acute or chronic inhalation and oral ingestion of radionuclides. The ICRP Task Force Lung Model (TGLM) was used as the inhalation model in ACRO, and a simple one-compartment model was used as the ingestion model. The program is written in FORTRAN IV, and it requires about 260 KB memory capacity.

THERMAL EFFECTS

PLANTS

34194 (DP-MS—80-37) **Productivity and species composition of algal mat communities exposed to a fluctuating thermal regime.** Tison, D.L.; Wilde, E.W.; Pope, D.H.; Fliermans, C.B. (Rensselaer Polytechnic Inst., Troy, NY (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 31p. (CONF-801032—1). NTIS, PC A03/MF A01.

From Stream ecology symposium; Augusta, GA, USA (19 Oct 1980).

Algal mat communities along a temperature gradient in a trough were found to release increased amounts of dissolved organic carbon during beginning and cessation of exposure to hot water. The fluctuating thermal regime, caused by operation of a Savannah River Plant production reactor, exposed the algal communities to 35 to 55°C during reactor operation, and 11 to 20°C when the reactor was shut down. Blue-green algae were the only phototrophic primary producers growing in water above 45°C. These thermophiles were able to survive and apparently adapt to ambient temperatures when the reactor was shut down. The algal mat exposed to < 45°C was composed of blue-green and eucaryotic algae which adapted rapidly to ambient temperatures.

INVERTEBRATES

REFER ALSO TO CITATION(S) 34195

VERTEBRATES

34195 (EPRI-EA—1148(Vol.1)) **Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report.** Larimore, R.W.; McNurney, J.M. (Illinois Natural History Survey, Urbana (USA)). Jul 1980. 90p. NTIS, PC A05/MF A01.

Volume 1 consists of (1) a statement of project objectives and a detailed description of the study areas, (2) a comparison of water quality in Lake Sangchris, a cooling lake, and Lake Shelbyville, a nearby flood control reservoir, and (3) a summary of the other three volumes.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 34183

34196 (BNL—51118, pp 116-118) **Potential effects of PV-related compounds on food webs.** Powers, C.D. (State Univ. of New York, Stony Brook). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Possible effects of photovoltaic-related compounds, including silica, polychlorinated biphenyls, and cadmium compounds on food chains are reviewed briefly. (JGB)

34197 (BNL—51118, pp 272-278) **Ranking methodology.** Harris, R.H. (Environmental Defense Fund, Washington, DC). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The need for setting research priorities is discussed. A project devoted to evaluating information on chemical carcinogens to see whether, within the data base involved, a methodology could be developed for systematically setting research priorities, is reviewed. Techniques used in the evaluation are discussed. (JGB)

34198 (LMF—75) **Low Btu gasifier emissions toxicology program. Status report October 1979.** Newton, G.J. (ed.). (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA)). Oct 1979. Contract AC04-76EV01013. 47p. NTIS, PC A03/MF A01.

Results to date from the physical, chemical, and biological characterization of potential toxicants in liquid, solid, and gaseous process streams of an experimental low Btu gasifier are summarized. Caution is advised on any conclusions since these results were obtained with a limited data base for a small experimental gasifier. The hypotheses proposed will be subjected to more rigorous testing in future sampling and analysis efforts.

34199 (ORNL/EIS—130) **Reviews of the environmental effects of pollutants. X. Toxaphene.** Durkin, P.R.; Howard, P.H.; Saxena, J.; Lande, S.S.; Santodonato, J.; Strange, J.R.; Christopher, D.H. (Syracuse Research Corp., NY (USA). Center for Chemical Hazard Assessment). Sep 1980. Contract W-7405-ENG-26. 500p. (EPA—600/1-79-044). NTIS, PC A21/MF A01.

The environmental effects of toxaphene are extensively reviewed. Information is presented on chemical properties and analytical techniques, environmental occurrence, cycling, and fate, as well as on food chain interactions. Biological aspects of toxaphene in microorganisms, plants, wild and domestic animals, and humans and test animals are reviewed, including metabolism, toxicity, carcinogenicity, mutagenicity, and teratogenicity.

CELLS

34200 (CONF-800485—1) **Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells.** Hsie, A.W.; San Sebastian, J.R.; Tan, E.L. (Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences; Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01.

From Workshop on the predictive value of in vitro short-term screening tests in carcinogenicity evaluation; Koevordon, Netherlands (28 Apr 1980).

A summary is presented on the development of a specific gene mutation assay, the Chinese hamster ovary cells/hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT) system, and the utilization of this system to study structure-activity relationship affecting cytotoxicity and gene mutation by various carcinogens. Then, preliminary development and validation of a Multiplex CHO System for the simultaneous determination of chromosome aberration, sister chromatid exchange in addition to cytotoxicity and gene mutation is presented. The potential use of a CHO/human cell hybrid system for measuring chromosomal deletion and loss is discussed.

MICROORGANISMS

34201 (DOE/ET/00222—4) **Exploratory research on mutagenic activity of coal-related materials.** Warshawsky, D.; Schoeny, R.S. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1980. Contract AS22-78ET00222. 42p. NTIS, PC A03/MF A01.

The following samples were found to be mutagenic for strains TA1538, TA98 and TA100 Salmonella typhimurium: ETTM-10, ETTM-11, ETTM-15, ETTM-16, and ETTM-17. ETTM-13 was marginally mutagenic for TA1537. ETTM-14 was slightly mutagenic for TA1537, TA1538, and TA98. Mutagenicity by all samples was demonstrated only in the presence of hepatic enzyme extracts (S9) which provided metabolic activation. ETTM-11 was shown to be the most mutagenic sample assayed thus far; specific activity was 2.79×10^4 TA98 revertants/mg sample. Fractionation by serial extractions with increasingly polar organic solvents was done at least 2 x with ETTM-10, ETTM-11, ETTM-15, ETTM-16 and ETTM-17. For some samples highly mutagenic fractions were observed.

PLANTS

34202 (NP—25070) **Response of confined aquatic biota to mine depressurization water in Beaver Creek Reservoir.** Jantzie, T.; Noton, L.R.; Chymko, N.R. (Chemical and Geological Labs. Ltd., Edmonton, Alberta (Canada)). Mar 1980. 86p. NTIS, PC A05/MF A01.

The response of selected species of aquatic biota to saline mine depressurization water after average dilution in the Beaver Creek Reservoir was investigated. Test organisms included periphyton, native fish species, and native invertebrates. Studies examined both short and long term effects. (ACR)

INVERTEBRATES

REFER ALSO TO CITATION(S) 34202

34203 (BNL—51118, pp 111-113) **Cadmium and arsenic in the environment.** Fowler, B.A. (National Inst. of Environmental Health Sciences, Research Triangle Park, NC). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The interactions of arsenic and cadmium in the environment are discussed. A simplified food chain is illustrated. The effects of the salinity of the water on uptake of Ca by the oyster is also illustrated. Data from tissue analysis of commercially available crab from the Los Angeles basin are also presented. (JGB)

34204 (DOE/EV/04580—T1) **Investigating the impact of drilling mud and its major components on bivalve species of Georges Bank. Progress report, March 1, 1979-February 29, 1980.** (New England

Aquarium Corp., Boston, MA (USA)). 1 Nov 1979. Contract AS02-77EV04580. 90p. NTIS, PC A05/MF A01.

Results described in Progress Report No. 1 indicate that 0.3 to 1.0 grams of drilling mud/liter of seawater can stress bivalve molluscs and that metallic components of drilling muds are assimilated by these organisms. The results posed questions about the short- and long-term effects of stress on energy stores, reproduction, and metal assimilation; accordingly, this year's research program has focused on these three areas and on a continued chemical characterization of the drilling muds used. The results are summarized; detailed procedures and data are given in the appendices.

VERTEBRATES

REFER ALSO TO CITATION(S) 34202, 34203

34205 (BNL—51118, pp 157-162) **Toxicology of boron and boron-containing materials.** Robinson, F.R. (Purdue Univ., West Lafayette, IN). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Results of a literature search on the toxicology of boron and boron compounds are reported. (JGB)

34206 (BNL—51118, pp 234-242) **Possible adverse effects of trace materials.** Davis, G.K. (Univ. of Florida, Gainesville). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

In addressing the question of research needs related to the problem of potential health effects of solar (photovoltaic) energy, one of the considerations is the possibility of adverse effects of trace materials. Included in the consideration are the elements selenium, arsenic, tellurium, cadmium, beryllium, silicon, boron, fluorine, chlorine, germanium, gallium, copper, silver, antimony, tin, and indium and their compounds. Chronic effects of low level exposure to these elements and the potential for synergistic action of low level exposure upon critical metabolic pathways are discussed. It is emphasized that well-balanced nutrition can be a major protective factor in an individual's response to trace material levels. (JGB)

MAN

REFER ALSO TO CITATION(S) 33240, 33387, 34205

34207 (BNL—51118, pp 163-173) **Toxicology of boranes and dichloromethane.** Back, K.C. 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The properties, chemistry, and toxicology of the two most toxic borane compounds, pentaborane and decaborane, are reviewed. Research on the toxic effect of dichloromethane is discussed briefly. (JGB)

34208 (BNL—51118, pp 174-179) **Toxicology of beryllium and beryllium-containing chemicals.** Robinson, F.R. (Purdue Univ., West Lafeyette, IN). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

A review is presented of the toxic effects of beryllium and beryllium compounds. Exposure guidelines are tabulated. (JGB)

34209 (BNL—51118, pp 180-188) **Cadmium toxicity and its relationship to other metals.** Spivey Fox, M.R. (Federal Drug Administration, Washington, DC). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The toxicological effects of Cd, sources of human Cd exposure, and its metabolism are discussed. Grains and cereals supply more Cd to the human diet than any other type of food. Results of studies on the relationships between essential nutrients in the diet and the adverse effects of Cd are reviewed. Recommendations are made for further research on Cd. (JGB)

34210 (BNL—51118, pp 189-196) **Toxicology of elements in dopants used in photovoltaic cells.** Haley, T.J. (Federal Drug Administration, Jefferson, AR). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Chemicals proposed for use in solar cells include: InSb, InAs, InP, InSe, In_2Te_3, CuSe, Cu_2Se, Cu_2SO_3, $CdSeO_4$, CdS, CdTe, AsGa, and GaP. Since toxicological information is lacking on these compounds but is available on each element, the discussion centers on the latter. It is pointed out that the elements might act synergistically in producing their toxic effects. (JGB)

34211 (BNL—51118, pp 206-217) **Toxicology of phosphorus, thiourea, and other chemicals.** Sax, N.I. (Medicol Lab., Boca Raton, FL). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The toxicity of phosphorus and thiourea is discussed. Information on the toxicity of thirty-six other materials that are candidates for the major components of photovoltaic cells is tabulated. (JGB)

34212 (BNL—51118, pp 218-225) **Carcinogens.** Albert, R.E. (New York Univ, New York). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Genesis of the approach and methods used for assessment and regulation of carcinogens by US Environmental Protection Agency (USEPA) are reviewed. Efforts by the federal government to obtain consistency among the various regulatory agencies, including, in addition to US EPA, the Federal Drug Administration, the Occupational Safety and Health Administration, and the Nuclear Regulatory Commission, are discussed. (JGB)

34213 (BNL—51118, pp 250-264) **In vitro tests and morbidity in man: special characteristics of inorganic materials.** Clarkson, T.W. (Univ. Medical Center, Rochester, NY). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Special characteristics of inorganic elements and compounds that distinguish them, at least in part, from organic chemicals and play an important role in the expression of their biological effects are discussed. Some common characteristics of metals and inorganic elements are as follows: metals are elements; they undergo oxidation-reduction reactions; they occur in both organic and inorganic compounds; they form complexes and chelates. Each of these is discussed. The general conclusions regarding testing for toxicity of inorganic trace materials are that in vitro tests have limited application, the dose-response relationship is different from that for organic carcinogens, and in vitro tests may turn out to be helpful in identifying susceptible individuals.

34214 (BNL—51118, pp 279-282) **Industrial toxicology.** Scala, R.A. (Exxon Corp., Linden, NJ). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Issues facing an industrial toxicologist are reviewed with emphasis placed on those of an emerging technology. Criteria for making the decisions as to whether materials should be tested for health effects are listed. (JGB)

34215 (BNL—51118, pp 197-205) **Carcinogenic, mutagenic, and teratogenic effects of cadmium and arsenic.** Lower, W.R. (Univ. of Missouri, Columbia). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Previously reported research on the toxicity of Cd and As is reviewed. Results of current research on environmental monitoring by means of biological systems are summarized. (JGB)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 34115, 34126, 34214

34216 (BNL—51118, pp 132-141) **Industrial hygiene surveys of semiconductor plants.** Gunter, B.J. (Department of Health, Education, and Welfare, Denver, CO). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

Results of industrial hygiene surveys conducted in two semiconductor plants are reported. Exposures, without proper protective clothing or equipment, to hydrofluoric or hydrochloric acids, epoxies used in soldering wire, and chronic acid used in electroplating, are potential health hazards. Cases of dermatitis due to acid exposure are illustrated. (JGB)

34217 (BNL—51118, pp 226-232) **Epidemiological considerations.** Hutchison, G.B. (Harvard Univ., Cambridge, MA). 1980.

From Workshop on the health effects of photovoltaic technology; Upton, NY, USA (31 Jul 1979).

The two types of epidemiological studies, retrospective and prospective, and differences in the approach to each, are discussed. Factors involved in planning epidemiological studies for a new industry are reviewed. (JGB)

34218 (PNL-SA—8202) **Assessment of the risk of transporting propane by truck and train.** Geffen, C.A.; Franklin, A.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract AC06-76RL01830. 17p. (CONF-800334—20). NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

An assessment of the risks of transporting propane by truck and train is presented. Risk assessment methodology is reviewed, and the results of its application to propane transportation systems are presented. Four basic steps are followed in the transportation risk assessment methodology to develop the information required to perform the risk analysis. These four basic steps are: a detailed description of the transportation system, including projected industry characteristics, size and number of shipments, material characteristics, container types, transport modes, routes traveled, and weather and population zones; the identification of possible material release sequences, using fault tree analysis; the evaluation of the probabilities and consequences of releases, using container failure data and mathematical models for dispersion and health effects; and, the calculation and assessment of risk, defined as the product of the probability of a release of material to the environment and the consequences of that release. (JGB)

GEOSCIENCES

REFER ALSO TO CITATION(S) 33682, 33683, 33684, 33685, 33686

34219 (DOE/ER—0071) **Summaries of physical research in the geosciences.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Aug 1980. 99p. NTIS, PC A05/MF A01.

The Department of Energy supports research in the geosciences in order to provide a sound underlay of fundamental knowledge in those areas of the earth, atmospheric, and solar/terrestrial sciences that relate to the Department of Energy's many missions. The Division of Engineering, Mathematical and Geosciences, which is a part of the Office of Basic Energy Sciences and comes under the Director of Energy Research, supports under its Geosciences program major Department of Energy laboratories, industry, universities and other governmental agencies. The summaries in this document, prepared by the investigators, describe the overall scope of the individual programs and details of the research performed during 1979-1980. The Geoscience program includes research in geology, petrology, geophysics, geochemistry, hydrology, solar-terrestrial relationships, aeronomy, seismology and natural resource analysis, including the various subdivisions and interdisciplinary areas. All such research is related to the Department's technological needs, either directly or indirectly.

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 33288, 33326, 33330

34220 (LBL—11178) **Physical aspects of the interface between the saturated and the unsaturated regimes.** Narasimhan, T.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 4p. (CONF-801050—1). NTIS, PC A02/MF A01.

From Subsurface contributions to steam flow conference; Durham, NH, USA (5 Oct 1980).

A short discussion is given of the physical properties of the transition zone between the saturated and unsaturated regimes of groundwater flow. Problems relative to modelling the flow are reviewed. (ACR)

GEOPHYSICS

SEISMOLOGY AND TECTONICS

34221 (UCRL—52956) **LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1980. Contract W-7405-ENG-48. 109p. NTIS, PC A06/MF A01.

The overall effects of the earthquakes of January 24 and 26, 1980, at the Lawrence Livermore National Laboratory in northern California are outlined. The damage caused by those earthquakes and how employees responded are discussed. The immediate emergency actions taken by management and the subsequent measures to resume operations are summarized. Long-range plans for recovery and repair, and the seisic history of the Livermore Valley region, various investigations concerning the design-basis earthquake (DBE), and seismic criteria for structures are reviewed. Following an analysis of the Laboratory's earthquake preparedness, emergency response, and related matters a series of conclusions and recommendations are presented. Appendixes provide additional information, such as persons interviewed, seismic and site maps, and a summary of the estimated costs incurred from the earthquakes.

34222 (UCRL—52969) **Dynamic behavior of LLNL buildings during aftershocks of the January 24, 1980 Greenville earthquake.** Murray. R.C.; Weaver. H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

Computer programs developed at the Lawrence Livermore National Laboratory (LLNL) were used to extract information about the dynamic behavior of several LLNL structures from velocity time-history signals recorded during two earthquake aftershocks. The most complete analysis was performed on Building 111. This analysis is presented as a case study to show the power of the LLNL computer codes in identifying the principal vibratory modes of a structure and the frequencies and damping values of these modes. The importance of this technique for monitoring changes in the seismic integrity of critical structures is discussed.

VOLCANOLOGY

34223 (PNL—2882) **Disruptive event analysis: volcanism and igneous intrusion.** Crowe, B.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01.

An evaluation is made of the disruptive effects of volcanic activity with respect to long term isolation of radioactive waste through deep geologic storage. Three major questions are considered. First, what is the range of disruption effects of a radioactive waste repository by volcanic activity. Second, is it possible, by selective siting of a repository, to reduce the risk of disruption by future volcanic activity. And third, can the probability of repository disruption by volcanic activity be quantified. The main variables involved in the evaluation of the consequences of repository disruption by volcanic activity are the geometry of the magma-repository intersection (partly controlled by depth of burial) and the nature of volcanism. Potential radionuclide dispersal by volcanic transport within the biosphere ranges in distance from several kilometers to global. Risk from the most catastrophic types of eruptions can be reduced by careful site selection to maximize lag time prior to the onset of activity. Certain areas or volcanic provinces within the western United States have been sites of significant volcanism and should be avoided as potential sites for a radioactive waste repository. Examples of projection of future sites of active volcanism are discussed for three areas of the western United States. Probability calculations require two types of data: a numerical rate or frequency of volcanic activity and a numerical evaluation of the areal extent of volcanic disruption for a designated region. The former is clearly beyond the current state of art in volcanology. The latter can be approximated with a reasonable degree of satisfaction. In this report, simplified probability calculations are attempted for areas of past volcanic activity.

GEOPHYSICAL SURVEY METHODS

34224 (USGS-OFR—80-611) **Complete Bouguer gravity map of the Tonopah 1° x 2° quadrangle, Nevada.** Healey, D.L.; Wahl, R.R.; Currey, F.E. (Geological Survey, Washington, DC (USA)). 1980. Contract AI08-76DP00474. 113p. NTIS, PC A06/MF A01.

The complete Bouguer gravity map of the Tonopah 1° x 2° quadrangle is a compilation of 3,346 gravity stations. Data for the majority of these stations were measured by field crews from the US Geological Survey. Data for 193 stations were obtained from the repository files of the US Department of Defense, Gravity Surveys Division, and are widely scattered over the map. Data for 127 stations were obtained from Northwestern University and are located in the western part of the map. The Nevada Bureau of Mines and Geology also established 146 stations in the area around Tonopah. The gravity-station values have all been converted to the International Gravity Standardization Network datum and the map is machine contoured.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 33327, 33331, 33332, 33333, 33338

34225 (LA-UR—79-3016) **Finite element modeling of long-term fluid-structure interaction problems in geological media.** Anderson, C.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-801003—3). NTIS, PC A02/MF A01.

From Symposium on computational methods in nonlinear structural and solid mechanics; Washington, DC, USA (6 Oct 1980).

A model is developed to predict long-term thermal creep and creep rupture in geological structures under multiaxial stress states and under elevated temperature conditions. An example of the

method is given showing the behavior of the crust and mantle while undergoing intrusion by a low density diaper. (ACR)

34226 (ONWI—95) **Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus.** Schrauf, T.W.; Pratt, H.R. (Terra Tek, Inc., Salt Lake City, UT (USA)). Dec 1979. Contract AC06-76RL01830. 88p. NTIS, PC A05/MF A01.

Current capabilities for the measurement of stress, displacement, and in situ deformation modulus in rock masses are reviewed as to their accuracy, sensitivity, advantages, and limitations. Consideration is given to both the instruments themselves and the measurement technique. Recommendations concerning adaptation of existing measurement techniques to repository monitoring are also discussed. These recommendations include: (1) development of a modified borehole deformation gage with improved long-term stability and reliability and reduced thermal sensitivity; (2) development of a downhole transducer type of extensometer; (3) development of a rigid inclusion type gage; (4) development of an improved vibrating wire stressmeter with greater accuracy and simplified calibration and installation requirements; and (5) modification of standard rod extensometers to improve their sensitivity.

34227 (ONWI—99) **Simulation of a bench scale experiment with an empirical creep law. Technical report.** Ratigan, J.L. (RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1979. Contract AC06-76RL01830. 49p. NTIS, PC A03/MF A01.

A priori predictions of the creep behavior of a planned bench scale experiment are presented. The experiment involves uniaxial loading of a large block of natural salt with a centrally located borehole. Primary measurements will include the borehole deformation. Sixteen material characterizations including four sets of elastic constants and four empirical creep power laws are developed from one standard deviation of the laboratory derived material properties and are used in the finite element simulation. Consideration is given to plane stress and plane strain solutions and to time-hardening and strain-hardening forms of the creep law. The results show that the deformations are relatively insensitive to variations in the elastic properties and very sensitive to the power on time in the empirical creep law. Differences in the results for the time-hardening and strain-hardening creep formations are small relative to the differences associated with varying the material parameters.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 33325

34228 (CONF-7905172—1) **Expression of embryonic hemoglobin genes in α-thalassemic and in β-duplication mice.** Popp, R.A.; Skow, L.C.; Whitney, J.B. III. (Oak Ridge National Lab., TN (USA); National Institutes of Health, Bethesda, MD (USA)). 1979. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 4. conference on Cooley's anemia; New York, NY, USA (21 May 1979).

The results of a study of the expression of embryonic hemoglobin genes in mice which show an imbalance of alpha and non-alpha chain synthesis are reported. (ACR)

34229 (LA—8473-MS) **Compilation of elemental concentration data for the United States geological survey's six geochemical exploration reference materials.** Gladney, E.S. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01.

Elemental composition data on USGS GXR1 → GXR6 have been collected and summarized from 13 journal papers and reports. Data from one report concerning the influence of rock dissolution method on subsequent atomic absorption analysis are summarized for aluminium, silver, calcium, iron, and manganese.

34230 **Characterization of the magmatic and fumarolic gases by their radioactive aerosols.** Lambert, G.; Bristeau, P.; Le Guern, F.; Polian, G.; Sabroux, J.C. *C. R. Seances Acad. Sci., Ser. D;* **288**: No. 8, 743-746(26 Feb 1979). (In French).

The study of different volcanic plumes has shown that the gases directly emitted from the magma have high lead, bismuth and polonium-210 concentrations. Fumarolic gases intensively filtered do not contain radioactive aerosols.

OCEANOGRAPHY

34231 (AD-A—076534) **The expanded ocean thermal-structure analysis system: a development based on the fields by information blending methodology. Final report.** Holl, M.M.; Cuming, M.J.; Mendenhall, B.R. (Meteorology International, Inc., Monterey, CA (USA)). Jul 1979. Contract N00014-79-C-0236. 220p. NTIS, PC A10/MF A01.

The Expanded Ocean Thermal-Structure (EOTS) analysis system, an application of the general-purpose Fields by Information Blending (FIB) methodology, is an advanced, comprehensive and flexible system for four-dimensional analysis of thermal structure from the ocean surface to the bottom. Using surface (ships, buoys, satellites) and sounding observations and information carried and accrued along the time axis from previous analyses and climatologies, analyses may be performed for any region and for any grid resolution in space and time. Significant variabilities in the vertical profile are represented by a set of thermal-structure parameters--absolute values, gradients and curvatures. Special provision is made for fine-resolution of thermal structure in the vicinity of the Primary Layer Depth and for restricting flow of information across land barriers. EOTS may be used for real-time synoptic analyses and, using available data bases, for production of historical sequences and climatologies. A wide variety of optional outputs includes horizontal and vertical sections of temperature and sound speed.

34232 **Benthic boundary-layer velocity profiles: Dependence on averaging period.** Lesht, B.M. (Ecological Sciences Section, Radiological and Environmental Research Division, Argonne National Labortory, Argonne, Illinois 60439). *J. Phys. Oceanogr.;* **10**: No. 6, 985-991(Jun 1980).

The relationship between benthic boundary-layer velocity profiles and current meter averaging time is investigated using (0.61 Hz) current measurements recorded within 1 m of the bottom on the inner continental shelf. The percentage of velocity profiles which correspond to the von Karma-Prandtl model of the neutrally stratified turbulent boundary layer increases rapidly as the averaging period is lengthened from a few second. When the averaging period exceeds ~20 times the characteristic time scale of the flow, the percentage of logarithmic profiles becomes independent of averaging period. This relationship is found for both wave and turbulence dominated flows. Increasing the averaging period beyond the minimum required to define stable mean values does not significantly change either estimates of mean friction velocity or the statistical distribution of the drag coefficient T_{100} computed from the observations.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 34234, 34282

STARS

REFER ALSO TO CITATION(S) 34237, 34353

34233 (LA-UR—80-2197) **^{56}Ni and the light curve of Type I supernova.** Colgate, S.A.; Petschek, A.G. (Los Alamos Scientific Lab., NM (USA)). 24 Jul 1980. Contract W-7405-ENG-36. 12p. (CONF-800370—2). NTIS, PC A02/MF A01.

From Supernova type I workshop; Austin, TX, USA (17 Mar 1980).

The explanation of SN Type I by radioactive decay of ^{56}Ni requires a relatively small value of the transparency function M/sub ej//v_9^5 = 0.22 in units of M/sub solar/'s and 10^9 cm s^{-1} to explain the light curve. A minimum mass of ^{56}Ni is required to explain the peak and near peak luminosity. Subsequent radioactive decay energy must escape in some other form than optical light in order to explain the rapid early and late time decay. Early ultraviolet and infrared radiation are excluded as sinks of energy by observations. PdV work is excluded by theory. The energy loss due to the escape of gamma rays and β^+'s with the above value of M/sub ej//v_9^2 gives good agreement with the light curve after maximum, provided essentially all the trapped energy is converted to optical light. The peak of SN 1972e is explained with the above transparency value M/sub ej//v_9^2 = 0.22 and mass of ^{56}Ni of 0.25 M/sub solar/ or 0.4 M/sub solar/, and a distance of 3.2 Mpc or 4 Mpc, respectively. These values depend critically upon the prediscovery report of Austin (1972), and the assumption again that all the radiation is emitted in the observed B and V bands by an efficient fluorescent (corona) conversion of uv.

34234 (LBL—8957, pp 241-260) **Astrophysics perspectives on high-energy nucleus-nucleus collisions.** Schramm, D.N.; Crawford, M.; Olive, K.A. (Univ. of Chicago, IL). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Various implications of high-energy heavy-ion collisions on astrophysics problems are reviewed. A discursive overview is given in four specific astrophysics areas: cosmic ray propagation an calibration studies; equation of state of neutron star matter and the maximum mass of a nuetron star; equation of state of collapsing stellar matter and the origin of black holes, neutron stars, and supernovas; and the quark-hadron phase transition in the early universe and the possible role it may play in generating fluctuations in the universe. References are given to reviews rather than to primary source material. (RWR)

34235 Luminosity of type I supernovae. Colgate, S.A.; Petschek, A.G.; Kriese, J.T. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico). *Astrophys. J., Lett. Ed.;* **237**: No. 3, L81-L85(1 May 1980).

We have recalculated the luminosity of type I supernovae by using (1) the diffusive release of Ni^{56} decay energy (Colgate and McKee), (2) the progressive gamma-ray transparency as calculated by a Monte Carlo gamma-ray simulation code, and (3) the fractional deposition of positrons (ARnett). If we take 100% optical fluorescence efficiency (Meyerott) and choose a nebula that is expanding uniformly and at constant velocity such that it is one γ-ray mean free path (35.5 g cm^{-2}) thick at 20 days, we obtain excellent agreement with observations. Three independent physical phenomena are involved. The first is the diffusive release of thermal radiation that with the 6.1 day Ni^{56} decay determines the height and width of the optical peak. The second is the initial fast decay of the optical peak by a factor of roughly 100 as determined by the progressive transparency to γ-rays. The third is the apparent 56 day half-life that results from the progressive escape of the positron fraction of the 77 day Co^{56} decay. To obtain agreement with observations, each of these three independent phenomena requires that the expanding nebula be described by a single relation M/sub ej/ v_9^{-3}=0.22 +- 0.05, where M/sub ej/ is the ejected mass in solar masses and v_9 is the expansion velocity in units of 10^9 cm s^{-1}. Total energy requirements exclude the possibility of the ejection of an envelope > or $\simeq$0.75 M/sub sun/, yet the optical luminosity requires that ~0.25 M/sub sun/ of the ejected matter be Ni^{56}.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

34236 (PPPL—1683) X-ray heating and ionization of broad-emission-line regions in QSO's and active galaxies. Weisheit, J.C.; Shields, G.A.; Tarter, C.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1980. Contract AM02-76CH03073. 35p. NTIS, PC A03/MF A01.

Absorption of x-rays deep within the broad-line emitting clouds in QSO's and the nuclei of active galaxies creates extensive zones of warm ($T \sim 10^4$K), partially ionized N/sub e//$N \sim 0.1$) gas. Because Lyman alpha photons are trapped in these regions, the x-ray energy is efficiently channeled into Balmer lines collisionally excited from the $n = 2$ level. The HI regions plus the HII regions created by ultraviolet photons illuminating the surfaces of the clouds give rise to integrated Lα/Hα line emission ratios between 1 and 2. Enhanced MgII line emission from the HI regions gives rise to integrated MgII/Hα ratios near 0.5. The OI line λ 8446 is efficiently pumped by trapped Hα photons and in the x-ray heated zone an intensity ratio I (λ 8446)/I(Hα) ~ < 0.1 is calculated. All of these computed ratios now are in agreement with observations.

GALAXIES

REFER ALSO TO CITATION(S) 34234

34237 Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds. Prasad, S.S.; Huntress, W.T. Jr. (Jet Propulsion Laboratory, California Institute of Technology). *Astrophys. J., Suppl. Ser.;* **43**: No. 1, 1-35(May 1980).

A time-dependent gas phase chemical model of the chemistry in interstellar clouds is presented which uses a comprehensive library consisting of over 1400 reactions for 137 species. Specified constant density, temperature, and radiation field intensity are used to generate the evolution with time of these species for 10^7 years in four model clouds to simulate the outer and inner components of zeta Oph and of Orion. No a priori assumptions are made concerning production and loss mechanisms, and the algorithm decides which are the major processes from an extensive list of potential production and loss mechanisms for each species. The C, N, and O families of chemical species are discussed in detail with particular emphasis on production and loss processes, and on the interrelationships among the chemistries of these families. A number of diagrams are used to illustrate the chemistry in interstellar clouds resulting from the models. The utility of the model is that it allows for easy testing of schemes for the chemistry and chemical evolution in interstellar clouds.

COSMOLOGY

REFER ALSO TO CITATION(S) 34234, 34300

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

34238 (ORNL/TM—7405) High voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, October 1, 1979-March 31, 1980. Christophorou, L.G.; James, D.R.; Pai, R.Y. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 117p. NTIS, PC A06/MF A01.

Topics covered include basic studies of gaseous dielectrics, direct current breakdown strengths of gases/mixtures, environmental effects studies and decomposition analyses, impulse studies, breakdown strengths of binary mixtures with concentric cylinder geometry, and a discussion of the experimental apparatus. (GHT)

34239 Valence bond diatomics-in-molecules (DIM) treatment of collinear interactions of Group IIa and IIb metal atoms with hydrogen halides: Application to the CaHCl system. Isaacson, A.D.; Muckerman, J.T. (Chemistry Department, Brookhaven National Labortory, Upton, New York 11973). *J. Chem. Phys.;* **73**: No. 4, 1729-1749(15 Aug 1980).

A recently developed formulation of the semiempirical valence bond diatomics-in-molecules (DIM) method is applied to the study of collinear MHX systems, where M is a Group IIa or IIb metal atom and X is a halogen atom. In particular, ground and excited state potential energy surfaces for reactions involving the three collinear arrangements of Ca, H, and Cl are considered. Explicit construction of the DIM Hamiltonian matrix is discussed. The resulting ground state surface for the collinear reaction Ca+ClH→CaCl+H, which exhibits a barrier of 34 kcal/mole at a rather stretched nuclear geometry, is shown to be in qualitative agreement with an ab initio surface for the analogous collinear Be+FH system. In addition, a description of the "harpooning" mechanism in the collinear reactions CaH+Cl→Ca+HCl and Cl+CaH→ClCa+H arises naturally from the calculations. Reaction pathways and reactant-to-product correlation diagrams are also discussed. A simple estimation of the sensitivity of the most prominent features of the calculated potential energy surfaces to the input diatomic fragment data demonstrates that these features cannot be attributed to errors made in those data.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 33870

34240 Crossed beam studies of low energy proton transfer reactions: H_2^+(Ar,H) HAr^+ from 0.4 to 7.8 eV (c.m.). Bilotta, R.M.; Preuninger, F.N.; Farrar, J.M. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *J. Chem. Phys.;* **73**: No. 4, 1637-1648(15 Aug 1980).

We present a crossed beam study of the proton transfer reaction H_2^+ (Ar,H) HAr^+ over an extended energy range. At the lowest collision energies (~0.4 eV), the reaction appears to proceed with substantial interaction among all three atoms, while the dynamics become "direct" in the higher energy regime. Collision induced dissociation of the HAr^+ product is observed for collision energies above ~2 eV, but products with internal energy in excess of the HAr^+ dissociation limit are observed in all cases. These observations are rationalized in terms of the metastability of HAr^+ products with rotational energy in excess of the dissociation limit. A surprisal analysis on the product translational energy distributions is also presented.

34241 Analytic study of azimuthal asymmetries in relativistic hollow e-beams. Epstein, B.G.; Poukey, J.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Phys. Fluids;* **23**: No. 8, 1596-1602(Aug 1980).

A study is made of zero-thickness relativistic hollow electron beams propagating in a vacuum guide field. The azimuthal variation in surface density for a beam emitted from an off-centered circular cathode is calculated exactly by solving Laplace's equation in a region between two eccentric conductors. The cathode problem is used as an initial state for solving the off-centered beam propagation problem in the drift region. The θ-bunching effect of the azimuthal asymmetries is estimated and related to specific experiments.

34242 Relativistic electron beam crossed-field device. Bekefi, G.; Orzechowski, T.J. (to Massachusetts Inst. of Tech.). US Patent 4,200,821. 29 Apr 1980. Filed date 17 Mar 1977. 6p.

PAT-APPL-778,392.

An intense relativistic crossed field device in a nested configuration wherein a field emission cathode is nested within a segmented annular anode with an annular gap separating the two.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 33939, 34261, 34372

34243 Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory. Johnson, W.R.; Cheng, K.T.; Huang, K.; Le Dourneuf, M. (Physics Department, University of Notre Dame, Notre Dame, Indiana 46556). W-31-109-ENG-38. *Phys. Rev., A;* **22**: No. 3, 989-997(Sep 1980).

The Beutler-Fano autoionizing resonances in the rare-gas atoms argon, krypton, and xenon are studied using the relativistic multichannel quantum-defect theory (MQDT). Dynamical parameters for the MQDT analyses are obtained from an ab initio relativistic-random-phase-approximation calculation. The position and profile of these resonances are in good agreement with experimental measurements. Angular distribution and spin polarization of photoelectrons in the resonance regions are also studied and are in close agreement with recent measurements.

34244 Radiative decay of the 2p ^{2}P/sub 3/2,1/2/ states of lithiumlike krypton (Z=36) and the 2s 2p $^3P_1$ state of berylliumlike krypton. Dietrich, D.D.; Leavitt, J.A.; Gould, H.; Marrus, R. (Department of Physics, University of Arizona, Tucson, Arizona 85721). *Phys. Rev., A;* **22**: No. 3, 1109-1115(Sep 1980).

The beam-foil time-of-flight technique has been used to measure the wavelengths and lifetimes of the $\Delta n=0$ transitions to the ground state 2p ^{2}P/sub 3/2,1/2/ $\rightarrow$ 2s ^{2}S/sub 1/2/ in lithiumlike Kr^{33+} and the intercombination transition 2s2p $^3P_1 \rightarrow 2s^2\ ^1S_0$ in berylliumlike Kr^{32+}. The following results are obtained for the transition, wavelength (A), and lifetime (nsec), respectively: Kr^{33+}: ^{2}P/sub 1/2/ $\rightarrow$ ^{2}S/sub 1/2/, 174.15 +- 0.26, 0.32 +- 0.03; Kr^{33+}: ^{2}P/sub 3/2/ $\rightarrow$ ^{2}S/sub 1/2/, 91.08 +- 0.10, 0.052 +- 0.003; Kr^{32+}: $^3P_1 \rightarrow {}^1S_0$, 169.9 +- 0.5, 2.3 +- 0.3. These results are compared with calculations.

34245 Raman scattering from NH_4^+ and ND_4^+ in beta-alumina. Bates, J.B.; Kaneda, T.; Wang, J.C.; Engstrom, H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **73**: No. 4, 1503-1513(15 Aug 1980).

Polarized Raman spectra in the internal and external mode region of NH_4^+ and ND_4^+ ions in beta-alumina have been measured. The forms of the scattering tensors for the internal modes are calculated taking into account the disordered distribution of ions on the crystallographic sites and treating each ion as an independent scattering center. The results of the analysis suggest that the ammonium ions occupy three nonequivalent sites in beta-alumina. Model calculations indicate that the ions prefer the Beevers—Ross and midoxygen sites with the C_2 axes of the ions located in the conducting plane. The librational modes of NH_4^+ and ND_4^+ evidently occur in the region from 200 to 450 cm^{-1}, but overlap with phonons of the host lattice precludes positive identification. The in-plane and out-of-plane translational modes are identified in the region between 100 and 200 cm^{-1}.

34246 Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan. Cooper, C.D.; Williamson, A.D.; Miller, J.C.; Compton, R.N. (Department of Physics, University of Georgia, Athens, Georgia 30602). *J. Chem. Phys.;* **73**: No. 4, 1527-1537(15 Aug 1980).

The resonantly enhanced multiphoton ionization (REMPI) spectra of pyrrole (C_4H_5N), N-methyl pyrrole (C_5H_7N), and furan (C_4H_4O) have been measured in the wavelength region from 365 to 680 nm. New and previously observed Rydberg states are reported for pyrrole and furan. Vibrational constants are presented for most of the Rydberg series. Accurate ionization potentials are derived for pyrrole (8.207 +- 0.003 eV) and N-methyl pyrrole (7.94 +- 0.02 eV). A strong two photon allowed transition is observed in N-methyl pyrrole at 41 193 cm^{-1} (0,0) and is attributed to an $^1A_2$ state. The corresponding state is not seen in pyrrole; however, it may be obscured by overlapping Rydberg series. Mass spectra following REMPI for benzene, pyrrole, and furan are reported. The degree of ionic fragmentation depends upon laser power density and wavelength.

34247 Infrared multiphoton excitation and inverse electronic relaxation in SO_2. Wolk, G.L.; Weston, R.E. Jr.; Flynn, G.W. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *J. Chem. Phys.;* **73**: No. 4, 1649-1656(15 Aug 1980).

Visible luminescence (λ=270—470 nm) has been observed from $S^{16}O_2$ and $S^{18}O_2$ at pressures of 0.2 to 20 Torr following irradiation by an intense infrared laser (λ=9.3 μm). Our experiments show that the luminescence is not due to dielectric breakdown or recombination of dissociation fragments, but rather is fluorescence from the first excited singlet states of SO_2 following inverse electronic relaxation from highly excited vibrational levels of the ground electronic state. Crossover from the ground to excited electronic states may also be collisionally assisted. Spectroscopic and kinetic measurements are consistent with previous studies on $^1B_1$ emission from SO_2. The pressure dependence of the fluorescence yield exhibits two distinct pressure regimes, while the dependence of visible emission on laser pump wavelength follows the small signal infrared absorption spectrum. The threshold for detection of fluorescence is 17—20 J/cm^2 with 9.3 μm radiation as the excitation source. These observations are discussed in terms of recently proposed theories which describe the photophysics of vibrationally excited states coupled to a radiative continuum through higher electronic states.

34248 Measured cross sections for the photoionization of ground state He to He^+(n=2). Woodruff, P.R.; Samson, J.A.R. (Synchrotron Radiation Center, University of Wisconsin-Madison, Stoughton, Wisconsin 53589). EY-76-S-02-2892A002. *Phys. Rev. Lett.;* **45**: No. 2, 110-113(14 Jul 1980).

Cross sections for simultaneous photoionization of He and excitation to He^+(n=2) have been measured from threshold to 160 eV. The data show clear evidence of autoionization from levels converging on He^+(n=3). Away from such structure, they are in good agreement with previous experimental values. None of the theoretical predictions gives the correct magnitude at low energies.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

34249 (BNL—28196) **Positive muon and the positron as probes of defects.** Lynn, K.G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 14p. (CONF-800855—9). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

The positive muon and the positron are each being used nowadays to investigate defects in condensed matter. A brief summary of the experimental methods employed with each particle is given in this paper. Similarities and differences between the behavior of the two leptons when implanted in consensed matter are pointed out, and by means of a comparison between muon and positron data in Al it is shown that the combination of muon and positron experiments can serve as a useful new probe of defects in solids.

34250 (LA—8407-PR, pp 28-34) **Negative muon capture ratios for alloys and alkali halide solid solutions.** Jun 1980.

In Medium-energy physics program. Progress report, August 1-October 31, 1979.

Muonic capture ratios for incident μ^- of 130 MeV/c are reported for Cu/Al and Ag/Zn alloys and NaCl/NaBr and KCl/KBr solid solutions of various concentrations. Cu and K muonic Lyman intensity patterns are also tabulated. It was concluded that no significant evidence was obtained for a concentration dependence of per-atom capture ratios for the materials studied. 7 tables. (RWR)

34251 (LA-UR—80-2373) **Temperature dependence of anomalous muonium hyperfine interactions in silicon.** Blazey, K.W.; Brown, J.A.; Cooke, D.W.; Dodds, S.A.; Estle, T.L.; Heffner, R.H.; Leon, M.; Vanderwater, D.A. (Rice Univ., Houston, TX (USA); Los Alamos Scientific Lab., NM (USA); Memphis State Univ., TN (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800855—6). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

The temperature dependence of the anomalous muonium hyperfine interaction has been measured in silicon. Between 5 and 150 K, an approximately 1% decrease is observed and attributed to interaction with the silicon host phonons.

34252 (LA-UR—80-2374) **DEMUR: double electron muon resonance.** Vanderwater, D.A.; Brown, J.A.; Cooke, D.W.; Dodds, S.A.; Estle, T.L.; Heffner, R.H.; Leon, M. (Rice Univ., Houston, TX (USA); Los Alamos Scientific Lab., NM (USA); Memphis State Univ., TN (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800855—5). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

The details of a general theory of DEMUR are presented, with examples of current experimental interest: quartz, where the hyperfine interaction is nearly isotropic; and silicon, wherein an anisotropic species has been found. The theory will be compared with experimental data.

34253 (LA-UR—80-2375) **Muon spin depolarization in nonmagnetic metals doped with paramagnetic impurities.** Heffner, R.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800855—2). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

The diffusion of muons and their magnetic interactions are treated by describing the physics to be learned from experiments which measure muon depolarization in metallic hosts doped with dilute concentrations of magnetic impurities. (GHT)

34254 (LA-UR—80-2376) **Depolarization of diffusing spins by paramagnetic impurities.** Schillaci, M.E.; Hutson, R.L.; Heffner, R.H.; Leon, M.; Dodds, S.A.; Estle, T.L. (Los Alamos Scientific Lab., NM (USA); Rice Univ., Houston, TX (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800855—4). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

The depolarization of diffusing spins (muons) interacting with dilute paramagnetic impurities in a solid was studied using a simple computational model which properly treats the muon motion and preserves correct muon-impurity distances. Long-range (dipolar) and nearest-neighbor (contact) interactions are treated together. Diffusion parameters are deduced and model comparisons made for AuGd (300 ppM).

34255 (LA-UR—80-2377) **Review of the experimental results on impurity centers in elemental semiconductors obtained by μSR and other techniques.** Estle, T.L. (Rice Univ., Houston, TX (USA). Dept. of Physics; Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800855—3). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

Selected electron paramagnetic resonance studies of defect centers in group IV semiconductors are reviewed. Features of this research which are useful in analyzing the nature of normal and anomalous muonium (Mu and Mu*) in these crystals are pointed out, and a moderately specific model of Mu and Mu* is presented and compared to studies of hydrogen in silicon and germanium.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 34240, 34250

34256 (COO—2718-8) **Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980.** Leventhal, J.J. (Missouri Univ., St. Louis (USA)). Feb 1980. Contract AS02-76ER02718. 15p. NTIS, PC A02/MF A01.

This report describes work performed during the past year. Apparatus was constructed for the purpose of studying laser-assisted charge transfer and work was begun on developing a novel method of measuring metal atom densities in the vapor phase. Modelling of energy transfer in molecular systems was continued and new results obtained.

34257 (PNL-SA—7417) **Secondary electron emission in ion-atom collisions.** Toburen, L.H.; Wilson, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 10p. (CONF-7906181—1). NTIS, PC A02/MF A01.

From 24. international meeting of the Institute of Management Science; Honolulu, HI, USA (15 Jun 1979).

The spatial distributions and correlation of stochastic energy deposition events produced in macromolecular volumes by a radiation field are of increasing importance in understanding radiation effects in biological materials. Studies of radiation action involving cell inactivation and mutation as well as single- and double-strand breaks in DNA indicate that energy deposition in volumes as small as nanometer dimensions may be required for interpretation. Correlation of spatial and temporal energy deposition events may be particularly important where the radiation effects result from pairing of sublesions within a specified volume. These examples demonstrate a clear need for knowledge of the energy concentrations randomly deposited in very small volumes in and near the paths of charged particles. Because direct measurement of energy deposition in such small sites is not technically feasible, it is necessary to develop mathematical models capable of calculating the desired quantities. Realistic computational methods, however, require a comprehensive data base of basic interaction cross sections. This data base must include interaction probabilities for the primary and all secondary radiation products. Of particular interest are the cross sections for the production of secondary electrons in primary ionizing events. In the present work, we will consider the extent to which this data base has developed regarding the interaction of fast charged particles with media of biological interest.

34258 **Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment.** Gray, T.J.; Cocke, C.L.; Justiniano, E. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Phys. Rev., A;* **22**: No. 3, 849-855(Sep 1980).

We report measured cross sections for the collisional production of highly charged low-velocity Ne recoil ions resulting from the bombardment of a thin Ne gas target by highly charged 1-MeV/amu C, N, O, and F projectiles. The measurements were made using time-of-flight techniques which allowed the simultaneous identification of the final charge state of both the low-velocity recoil ion and the high-velocity projectile for each collision event. For a given incident-projectile charge state, the recoil charge-state distribution is very dependent upon the final charge state of the projectile. Single- and double-electron capture events by incident bare nuclei and projectile K-shell ionization during the collision cause large shifts in the recoil charge-state distributions toward higher charge states. A previously proposed energy-deposition model is modified to include the effects of projectile charge-changing collisions during the collision for bare and hydrogenlike projectiles and is used to discuss the present experimental results.

34259 **Scaled proton ionization cross sections in the Born approximation.** McGuire, E.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Rev., A;* **22**: No. 3, 868-881(Sep 1980).

Using the generalized oscillator strength formulation of the Born approximation, proton ionization cross sections were calculated for a large sample of subshells of atoms throughout the periodic table. The results are presented in the form of scaled cross sections for all subshells up to the 6p. Comparison with measurements shows reasonable agreement (better than a factor of 2), with some exceptions, for the proton energy range studied. The scaled cross sections presented herein are limited, in general, to proton energies greater than 184 times the subshell ionization energy.

34260 **K- and L-shell vacancy sharing between light projectiles and argon targets.** Reed, K.J.; Garcia, J.D.; Fortner, R.J.; Stolterfoht, N.; Schneider, D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev., A;* **22**: No. 3, 903-908(Sep 1980).

Auger electron measurements were made to determine vacancy-production cross sections in collisions of various light projectiles with argon atoms for projectile energies ranging from 30 to 600 keV. Ratios of projectile K-shell to argon L-shell vacancies were determined for comparison with theoretical models. Several different ab-initio molecular-orbital and total-energy calculations were performed and compared for use in calculating theoretical sharing ratios. Total-energy differences for molecular states with inner-shell vacancies were compared with molecular-orbital energy differences. The experimental ratios are only moderately well reproduced using current theoretical models with model parameters derived from the ab-initio calculations.

34261 **Large-momentum-transfer limit of some matrix elements.** Wadehra, J.M.; Spruch, L. (double-daggerepartment of Physics, New York University, New York, New York 10003). *Phys. Rev., A;* **22**: No. 3, 956-967(Sep 1980).

The matrix element ϵ/sub i/f(K), or ϵ, that appears in the study of elastic and inelastic electron-atom scattering from an initial state i to a final state f in the first Born approximation depends explicitly on the momentum transfer h-bar K → The uncertainty in the value of the calculated cross sections arises not only from the application of the Born approximation but also from the approximate nature of the wave functions used. For the 1 ^{1}S-2 ^{1}P transition in helium, we present an analytic expression in terms of the 1 ^{1}S and 2 ^{1}P wave functions for the leading coefficient C_1 in the asymptotic expansion of ϵ as a power series in 1/K; C_1 is defined by $\epsilon \sim C_1/K^8$ as $K \sim \infty$. An accurate numerical value of C_1 is obtained by using a sequence of better and better 1 ^{1}S and 2 ^{1}P wave functions. An accurate value of C_1 can be useful in obtaining an approximate analytic form for the matrix element. We also present analytic expressions, in terms of the 1 ^{1}S wave function, for the coefficients of the two leading terms of ϵ for the diagonal case, that is, for the atomic form factor, and we obtain accurate estimates of those coefficients. We also give a very simple approximate result, valid for a number of matrix elements of heavy atoms, for the ratios of the coefficients of successive terms (in the asymptotically high-K domain) in a power series in 1/K. Finally, we plot ϵ for 1 ^{1}S to 1 ^{1}S and for 1 ^{1}S to 2 ^{1}P, with the known low-K and high-K dependence extracted. The 1 ^{1}S to 1 ^{1}S plot varies considerably as one goes to high K, and the 1 ^{1}S to 2 ^{1}P plot shows a very rapid variation for K $\sim \infty$, strongly suggesting that at least one element of "physics": perhaps a pole outside of but close to the domain of convergence: has been omitted.

34262 **Brochure of the Picosecond Laser and Spectroscopy Laboratory.** New York, NY; City College (1980). 53p. (NP—25009).

The Picosecond Laser and Spectroscopy Laboratory uses laser clocks to study molecular processes directly in the time domain. The PLS is equipped with state-of-the-art instrumentation of modern fast-kinetic laser spectroscopy. This equipment is used to perform research in solid-state physics, liquid state physics, chemical physics, and photobiology. Research programs in these areas are reported. (GHT)

ATOMIC AND MOLECULAR THEORY

34263 (DOE/ER/01198—T1) **Segment density functions of polymer chains confined by absorbing or reflecting barriers.** Paisner, M.J. (Illinois Univ., Urbana (USA). Graduate Coll.). Jul 1980. Contract AC02-76ER01198. 59p. NTIS, PC A05/MF A01.

Thesis.

A theoretical investigation into the segment density profile of confined chains has been undertaken herein, where the confinement is between a pair of infinite parallel walls which are reflecting or absorbing. Exact infinite series expressions are derived for the segment density functions of cilia, loops, bridges, and floating chains. These infinite series are easily evaluated numerically.

34264 Theory of resonance-radiation pressure. Cook, R.J. (University of California, Lawrence Livermore Laboratory, P. O. Box 5508, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev., A;* **22**: No. 3, 1078-1098(Sep 1980).

A general theory of the motion of a two-level atom in a resonant or near-resonant electromagnetic wave of arbitrary amplitude and phase, including effects of radiative relaxation due to interaction with the quantized vacuum field, is developed from first principles. Particular emphasis is placed on the effects of quantum-mechanical fluctuations of the radiation force and on the associated diffusion of atomic momentum due to spontaneous and induced absorption and emission processes. Analytic results and numerical examples are presented for (1) the lower bound on the temperature achievable by radiation cooling in a standing wave tuned below resonance, (2) the heating rate in a strong resonant standing wave, (3) the maximum confinement time for an atom in a Gaussian radiation trap, (4) the deflection and spreading of an atomic beam transversely illuminated by a strong resonant running wave, and (5) the transverse cooling of an atomic beam by a strong running wave tuned below resonance.

FLUID PHYSICS

GENERAL FLUID DYNAMICS

34265 Vortex simulations of the Rayleigh—Taylor instability. Baker, G.R.; Meiron, D.I.; Orszag, S.A. (Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Fluids;* **23**: No. 8, 1485-1490(Aug 1980).

A vortex technique capable of calculating the Rayleigh—Taylor instability to large amplitudes in inviscid, incompressible, layered flows is introduced. The results show the formation of a steady-state bubble at large times, whose velocity is in agreement with the theory of Birkhoff and Carter. It is shown that the spike acceleration can exceed free fall, as suggested recently by Menikoff and Zemach. Results are also presented for instability at various Atwood ratios and for fluids having several layers.

34266 Vapor/liquid interaction and entrainment in falling film evaporators. Yung, D.; Lorenz, J.J.; Ganic, E.N. (Components Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Heat Transfer;* **102**: No. 1, 20-25(Feb 1980).

The problem of vapor/liquid interaction and entrainment in falling film evaporators is analyzed. Attention is focused primarily on horizontal tube falling film evaporators where liquid falls from one tube to the next in either a droplet or column mode. A criterion is presented for the onset of column formation, and equations are derived for the deflection of droplets and columns due to vapor crossflow. Based on an experimental study of drop detachment and breakup, a correlation is established for the resulting droplet sizes. For high vapor crossflow velocities, a criterion is presented for the inception of liquid entrainment by a process known as stripping. Based on the foregoing models, conditions are defined under which vapor/liquid interaction and entrainment are important for falling film evaporators.

PROPERTIES AND STRUCTURE OF FLUIDS

34267 Fluctuation expressions for nonequilibrium distribution functions in adiabatic flows. Evans, D.J.; Hoover, W.G.; Ladd, A.J.C. (National Bureau of Standards, Boulder, Colorado 80302). W-7405-ENG-48. *Phys. Rev. Lett.;* **45**: No. 2, 124-125(14 Jul 1980).

A "non-equilibrium Hamiltonian" that describes adiabatic deformation has recently been used to obtain the bulk and shear viscosities of simple fluids. This Hamiltonian is used to derive equilibrium fluctuation expressions for the non-equilibrium distribution functions, studying in detail the most important of these, the pair distribution function for simple fluids in the linear-response regime.

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 33746

HIGH ENERGY PHYSICS

34268 (DOE/ER/03072—T2) Research highlights for the period February 1, 1980-July 31, 1980. Shoemaker, F.C. (Princeton Univ., NJ (USA). Joseph Henry Labs.). 1 Aug 1980. Contract AC02-76ER03072. 5p. NTIS, PC A02/MF A01.

Very brief summaries of research during the period February 1, 1980 to July 31, 1980 are given. The subjects included muon interactions, charmed particles, muon pair production, and the eta/sub c/ meson. Completed work has been published. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 34066

34269 (DOE/ER—0066) High Energy Physics Advisory Panel. A report of the 1980 Subpanel on review and planning for the US High Energy Physics Program. (Department of Energy, Washington, DC (USA). Div. of High Energy Physics). Jul 1980. 67p. NTIS, PC A04/MF A01.

The status of high energy physics in the US is examined, and some recommendations for future activities in this field are made: utilization of the forefront accelerator facilities should be intensified, the new superconducting projects should proceed with all deliberate speed, and increasing support should be devoted to detector and accelerator R and D. (RWR)

ELECTROMAGNETIC INTERACTIONS

34270 (BNL—28142) Search for narrow structures in the anti pp annihilation cross section from 1925 to 1955 MeV. Lowenstein, D.I.; Peaslee, D.C.; Bromberg, C. (Brookhaven National Lab., Upton, NY (USA); Department of Energy, Washington, DC (USA); Michigan State Univ., East Lansing (USA). Dept. of Physics; Syracuse Univ., NY (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-800688—2). NTIS, PC A02/MF A01.

From 5. European symposium on nucleon-antinucleon interactions; Bressanone, Italy (Jun 1980).

The anti pp annihilation cross section has been measured over the CM energy range 1925 to 1955 MeV with an RMS resolution of +-2.5 MeV on the average. This search yields no evidence for narrow enhancements in the S(1936) region. Using an A + B/p dependent background, a two standard deviation upper limit of 9 mb-MeV is set for the integrated area of any resonance with mass between 1936 and 1942 and with width $\leqq$ 4 MeV.

34271 (COO—3071-248) Are high-p/sub T/ events dominated by non-jet processes. Selove, W. (Pennsylvania Univ., Philadelphia (USA)). Jun 1980. Contract AC02-76ER03071. 5p. (CONF-800724—12). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Large cross sections and apparent non-jet structure have recently been reported for a large acceptance high-p/sub T/ experiment. It is shown that he experimental information is in fact consistent with dominance of 2-jet type events, with a modest number of low-p/sub T/ background particles also present.

34272 (DOE/ER/02232—88) Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer. Cool, R.L.; Goulianos, K.; Segler, S.L.; Sticker, H.; White, S.N. (Rockefeller Univ., New York (USA)). Jul 1980. Contract AC02-76ER02232. 21p. (CONF-800724—14). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

We have measured the elastic differential cross section for p/sup +-/p, π/sup +-/p and K/sup +-/p at 100 GeV/c and 200 GeV/c in the range 0.03 < vertical bar t vertical bar < 0.10 (GeV/c)^2. We find that in this t range the data display a simple exponential dependence. Our slope parameters are consistent with other measurements in this region and with extrapolations from higher t. Data for $\pi^- p \rightarrow \pi^- p$ at lower values of t appear to have significantly higher slopes. A discontinuous break in the differential cross section would violate unitarity. We find that the data can be fitted by a continuous, albeit rapidly changing, function of t that satisfies unitarity constraints.

34273 (FERMILAB-CONF—80/56-EXP) Slope parameter for the differential cross-section for the reaction p + d → X + d in the region of small momentum transfer at Fermilab energies. Akimov, Yu. K.; Bartenev, V.D.; Izyurov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR); Sofia Univ. (Bulgaria); Institute of Nuclear Research, Warsaw (Poland); Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA); Arizona Univ., Tucson (USA)). Jun 1980. Contract AC02-76CH03000. 6p. (CONF-800724—16). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A deuterium gas jet target was used in the circulating beam of the Fermilab accelerator to study the M²/sub x/ and s dependence and the slope parameter for pd → Xd in the region 0.025 ≦ vertical bar t vertical bar ≦ 0.17 (GeV/c)² and 5 ≦ M²/sub x/ ≦ 0.068s GeV². A simple parametrization in terms of the variable (1 - x) is found.

34274 (LA-UR—80-1976) **Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region.** Ransome, R.D.; Hollas, C.L.; Riley, P.J. (Texas Univ., Austin (USA); Los Alamos Scientific Lab., NM (USA); Texas A and M Univ., College Station (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—16). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The spin transfer parameters K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ have been measured for np elastic scattering at 800 MeV between 165° and 180° c.m. The parameters K/sub NN/ and K/sub LL/ are in good agreement with the quasi-free reaction polarized pd → polarized npp at 180°.

34275 (LA-UR—80-2371) **Models for positive muon depolarization in spin glasses for zero external field.** Leon, M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800855—8). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

Models for positive muon depolarization in spin glass systems with zero external field are considered.

34276 (SLAC-PUB—2519) **Radiative transitions from the psi (3095) to ordinary hadrons.** Scharre, D.L. (Stanford Linear Accelerator Center, CA (USA)). May 1980. Contract AC03-76SF00515. 25p. (CONF-8004102—2). NTIS, PC A02/MF A01.

From 6. international conference on experimental meson spectroscopy; Upton, NY, USA (25 Apr 1980).

Preliminary results from the Mark II and Crystal Ball experiments on radiative transitions from the psi to ordinary hadrons are presented. In additon to the previously observed transitions to the eta, eta'(958), and f(1270), both groups observe a transition to a state which is tentatively identified as the E(1420).

34277 **Charmed mesons produced in e^+e^- annihilations.** Goldhaber, G. (California Univ., Berkeley (USA). Dept. of Physics). *Phys. Scr.;* **20**: No. 2, 254-264(Aug 1979).

Charmed mesons D^0, D^+ and F^+ produced in e^+e^- annihilation are discussed. The emphasis is on the most recent results. In particular preliminary performance characteristics and results from the new SLAC-LBL Mark II detector at SPEAR are presented.

34278 **From the psi to charm: The experiments of 1975 and 1976.** Richter, B. (Stanford Univ., CA (USA)). *Cesk. Cas. Fys.;* **28**: No. 4, 323-348(Sep 1978). (In Czech).

The lecture given by B. Richter at the award ceremony of the Nobel Prize for Physics for 1976 is presented. The history of experiments which led to the discovery of new psi particles is described. Also described is a four-quark model. The grounds are explained for the introduction of a new quark system, charmonium.

WEAK INTERACTIONS

34279 (SLAC-PUB—2517) **Two-photon interactions from Mark II at SPEAR.** Hollebeek, R. (Stanford Linear Accelerator Center, CA (USA)). May 1980. Contract AC03-76SF00515. 10p. (CONF-800374—6). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

Results on the two-photon production of the eta', f(1270), A_2(1310), and f'(1515) mesons at SPEAR energies are presented using data taken with the Mark II detector. The radiative width of the eta' has been determined to be Γ/sub γγ/(eta') = 5.8 +- 1.1 keV (20% systematic uncertainty). Upper limits for the radiative widths of the f, A_2, and f' have been determined.

34280 (SLAC-PUB—2532) **Ratio of D^0 and D^+ lifetimes from their semileptonic decays.** Donaldson, G.J. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 32p. (CONF-800123—4). NTIS, PC A03/MF A01.

From Orbis Scientiae; Coral Gables, FL, USA (14 Jan 1980).

The conventional expectation for the decays of D mesons assumes that the charm quark decays in the presence of light, spectator quarks and thus the lifetimes of both charged and uncharged states are equal. In this article, evidence is presented from DELCO (at SPEAR) that the D lifetimes are quite different for neutral and charged mesons, and the results which have also become available from other experiments are reviewed.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 34321

34281 (FERMILAB-CONF—80/57-EXP) **Upper limits on phi phi production in 350 GeV/c proton-beryllium collisions.** Yamanouchi, T.; Brown, B.C.; Brown, C.N. (Fermi National Accelerator Lab., Batavia, IL (USA); State Univ. of New York, Stony Brook (USA)). May 1980. Contract AC02-76CH03000. 7p. (CONF-800724—15). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A sensitive upper limit has been established on phi phi resonance production by 350 GeV/c protons incident on a beryllium target. The 90% confidence level upper limit varies from 1.5 x 10^{-30} cm^2/nucleon at M/sub phi phi/ = 2.8 GeV/c^2 to 6.0 x 10^{-32} cm^2/nucleon at M/sub phi phi/ = 3.4 GeV/c^2. No evidence of the eta/sub c/ is observed.

34282 (LBL—8957, pp 139-193) **Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions.** Yodh, G.B. (National Science Foundation, Washington, DC). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

This lecture concentrates on two aspects of what is known from cosmic rays about nucleus-nucleus interactions: what part of cosmic ray physics immediately would benefit from having a 20-GeV per nucleon machine colliding with 20 GeV per nucleon and how it might be relevant to some cosmic ray questions, and the unusual cosmic ray events called Centauro events. The origin, acceleration, and propagation of cosmic rays are touched upon, with a description of the leaky box model. A typical cosmic ray experiment and its data analysis are described. Then the Centauro events are discussed. The most significant point is that the number of associated gamma rays and electrons is very small, while the total number of hadrons is of the order of 100; these events have no accepted explanation. 16 figures, 4 tables. (RWR)

34283 (LBL—8957, pp 281-325) **High p/sub T/ transverse momentum physics at the CERN ISR.** Albrow, M.G. . (Rutherford High Energy Lab., Chilton, England). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Experiments at the CERN ISR involving high transverse momentum are reviewed under the following headings: the Intersecting Storage Rings, introduction to high transverse momenta, single-particle spectra, correlations and event structure, experimental detectors, general features of event structure, and nuclear collisions. It is now generally believed that most high-p/sub T/ events actually consist of something like four jets of hadrons: two in the beam directions, resulting from fragmentation of the spectator constituents, and two high-p/sub T/ jets. Essentially all data are compatible with a model involving hard scattering between proton constituents. Probably several types of constituents are needed: quarks, antiquarks, gluons, and possibly mesons. 22 figures. (RWR)

STRONG MESON-INDUCED INTERACTIONS

34284 (BNL—28057) **Search for narrow states produced in the reaction $\pi^- p \to n + \gamma$'s at 13 GeV/c.** Chiang, I-H.; Johnson, R.A.; Kwan, B. (Brookhaven National Lab., Upton, NY (USA); Illinois Univ., Urbana (USA); Princeton Univ., NJ (USA)). 7 Jul 1980. Contract AC02-76CH00016. 6p. (CONF-8004102—1). NTIS, PC A02/MF A01.

From 6. international conference on experimental meson spectroscopy; Upton, NY, USA (25 Apr 1980).

A double arm lead-glass lead-scintillator calorimeter system was used to search for narrow states, such as the eta/sub c/, produced in the exclusive reactions $\pi^- p \to \gamma\gamma n$, $\pi^- p \to \pi^0 \gamma n$, and $\pi^- p \to \pi^0\pi^0 n$ at 13 GeV/c. A 90% c.l. upper limit sigma.BR < 260 pb was found for γγ states with masses from 2.6 to 3.1 GeV/c^2. Corresponding limits on narrow $\pi^0\gamma$ and $\pi^0\pi^0$ states are also given.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

REFER ALSO TO CITATION(S) 34300

GENERAL

REFER ALSO TO CITATION(S) 34305

34285 **Link-operator formulation of quark confinement without van der Waals forces.** Greenberg, O.W.; Hietarinta, J. (Physics Department, Brookhaven National Laboratory, Upton, New York

11973). EY-76-C-02-0016. *Phys. Rev., D;* **22**: No. 4, 993-998(15 Aug 1980).

We give a second-quantized model in which, using link operators, quarks and antiquarks are permanently confined without color van der Waals forces between hadrons. We also sketch how to include short-range interactions between hadrons, quark-antiquark creation and annihilation, and, string breaking.

34286 Regge slopes in dual topological expansion. Tan, C. (Physics Department, Brown University, Providence, Rhode Island 02912). EY-76-C-02-3130.A003. *Phys. Rev., D;* **22**: No. 4, 1024-1036(15 Aug 1980).

The structure of the dual topological expansion is studied up to the cylinder level by concentrating on the determination of Reggeon and Pomeron slopes. A precise formulation for the generation of Regge behavior in terms of an effective random walk is presented, and a well-defined meaning is provided for the trajectory slope in terms of average step lengths in the rapidity and the impact-parameter directions. The smallness of the Pomeron slope, α/sub P//sup prime//α_0/sup prime/ $\sim$ 0.3, is shown to represent a nontrivial constraint for theories satisfying the requirement of short-range ordering; a topological phase consideration is shown to be the primary mechanism responsible for this phenomenon. The relation between our finding to the naive expectation α/sub P//sup prime//α_0/sup prime/ $\simeq$ 1/2 based on a string picture and to the general phenomenon of the f/P identity is clarified.

34287 Particle ratios, quarks, and Chao-Yang statistics. Chew, C.K.; Low, G.B.; Lo, S.Y. (Nanyang Univ. (Singapore). Dept. of Physics); Phua, K.K. (Argonne National Lab., IL (USA)). *J. Phys., G (London);* **6**: No. 1, 17-24(Jan 1980).

By introducing quarks into Chao-Yang statistics for 'violent' collisions, particle ratios are obtained which are consistent with the Chao-Yang results. The present method can also be extended to baryon-meson and baryon-antibaryon ratios.

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 34301

34288 (SLAC-PUB—2503) **Two-photon collisions and QCD.** Gunion, J.F. (California Univ., Davis (USA). Dept. of Physics; Stanford Univ., CA (USA)). May 1980. Contract AC03-76SF00515. 25p. (CONF-800499—2). NTIS, PC A02/MF A01.

From International workshop on gamma-gamma collisions; Amiens, France (8 Apr 1980).

A critical review of the applications of QCD to low- and high-p/sub T/ interactions of two photons is presented. The advantages of the two-photon high-p/sub T/ tests over corresponding hadronic beam and/or target tests of QCD are given particular emphasis.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 34392

34289 (FERMILAB-CONF—80/63-THY) **(Quark)onium theory and spectroscopy.** Quigg, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1980. Contract AC02-76CH03000. 2p. (CONF-800724—7). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Introductory remarks to Parallel Session C7 at the XXth International Conference on High Energy Physics are presented.

34290 (FERMILAB-CONF—80/66-THY) **Penguins and the $\Delta I = 1/2$ rule.** Hill, C.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1980. Contract AC02-76CH03000. 4p. (CONF-800724—20). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A discussion is presented of the role of penguin operators in the weak decays of light particles, including an extra operator, O_7, entering in two loops. The evidence for large penguin contributions is reviewed and found to be uncompelling. 2 figures, 1 table.

34291 (SLAC-PUB—2510) **PSI radiative decays.** Feldman, G.J. (Stanford Linear Accelerator Center, CA (USA)). May 1980. Contract AC03-76SF00515. 11p. (CONF-800374—7). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

Inclusive and exclusive measurements of psi radiative decay are presented. The magnitude of hard inclusive radiative decay is comparable to the prediction f first order QCD, but the measured spectrum is considerably softer. In addition to measurements of radiative decays to the known pseudoscalar and tensor mesons, a sizable decay to a resonance of mass 1440/sub -15/$^{+10}$ MeV/c^2 in the K anti Kπ mode is observed. This may be the E(1420) meson. Supporting evidence is presented for the existence of the n/sub c/ at a mass of 2980 MeV/c^2.

34292 tauν decay signature for detecting F^{+-} and B^{+-} mesons in e^+e^- collisions. Barger, V.; Leveille, J.P.; Stevenson, P.M.; Phillips, R.J.N. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). DE-AC0276ER00881,C00-881-129. *Phys. Rev. Lett.;* **45**: No. 2, 83-85(14 Jul 1980).

The decay modes F(cs-bar), B(bu-bar,bc-bar)$\rightarrow$tauν are proposed as triggers for $e^+e^-\rightarrow$FF-bar,BB-bar production. Decay branching fractions of order B(F)$\simeq$15% and B(B)$\simeq$(1 to 2)% are estimated. The sequential tau$\rightarrow e\nu$nu-bar, $\mu\nu$nu-bar decays provide clear signatures, with the hadronic decay of the associated F,B carrying exactly half the energy. These triggers can be extended to study F^* and B^* resonance production and also to exploit the tau$\rightarrow\pi\nu$,rhoν, $A_1\nu$ decays.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 34299, 34359

34293 (LA-UR—80-2235) **Role of valons in low-p/sub T/ physics.** Hwa, R.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 15p. (CONF-8006108—2). NTIS, PC A02/MF A01.

From 11. international symposium on multiparticle dynamics; Bruges, Belgium (22 Jun 1980).

Hadron structure is described in the framework in which a nucleon is treated as a composite system of three valence quark clusters, called valons. Their momentum distribution is extracted from deep inelastic scattering data. The valon representation provides a quantitative description of the recombination function, which characterizes the hadronization of quarks. A formalism is then developed in terms of valons and quarks such that the inclusive distributions for hadronic reactions at low-p/sub T/ can be calculated without free parameters. 1 figure.

34294 (SLAC-PUB—2505) **Possibility of detecting triple gluon coupling and Adler-Bell-Jackiw anomaly in polarized deep inelastic scattering.** Lam, C.S.; Li, B.A. (Stanford Linear Accelerator Center, CA (USA)). May 1980. Contract AC03-76SF00515. 19p. (CONF-800724—8). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A way to detect experimentally the existence of triple gluon coupling and the Adler-Bell-Jackiw anomaly is to measure the Q^2-dependence of polarized deep inelastic scattering. These effects lead to a ln ln Q^2 term which we calculate by introducing a new gluon operator in the Wilson expansion.

34295 Elaboration of the recently proposed test of Pauli's principle under strong interactions. Ktorides, C.N.; Myung, H.C.; Santilli, R.M. (Harvard University, Science Center, Cambridge, Massachusetts 02138). ER-78-S-02-4742.A000;ASO-78ER04742. *Phys. Rev., D;* **22**: No. 4, 892-907(15 Aug 1980).

The primary objective of this paper is to stimulate the experimental verification of the validity or invalidity of Pauli's principle under strong interactions. We first outline the most relevant steps in the evolution of the notion of particle. The spin as well as other intrinsic characteristics of extended, massive, particles under electromagnetic interactions at large distances might be subjected to a mutation under additional strong interactions at distances smaller than their charge radius. These dynamical effects can apparently be conjectured to account for the nonpointlike nature of the particles, their necessary state of penetration to activate the strong interactions, and the consequential emergence of broader forces which imply the breaking of the SU(2)-spin symmetry. We study a characterization of the mutated value of the spin via the transition from the associative enveloping algebra of SU(2) to a nonassociative Lie-admissible form. The departure from the original associative product then becomes directly representative of the breaking of the SU(2)-spin symmetry, the presence of forces more general than those derivable from a potential, and the mutated value of the spin. In turn, such a departure of the spin from conventional quantum-mechanical values implies the inapplicability of Pauli's exclusion principle under strong interactions, because, according to this hypothesis, particles that are fermions under long-range electromagnetic interactions are no longer fermions under these broader, short-range, forces. In nuclear physics possible deviations from Pauli's exclusion principle can at most be very small. These experimental data establish that, for the nuclei considered, nucleons are in a partial state of penetration of their charge volumes although of small statistical character.

STRONG INTERACTIONS, BARYON NO.=0

34296 Determination of the pion and kaon structure functions. Aitkenhead, W.; Barton, D.S.; Brandenburg, G.W.; Busza, W.;

Dobrowolski, T.; Friedman, J.I.; Kendall, H.W.; Lyons, T.; Nelson, B.; Rosenson, L.; Toy, W.; Verdier, R.; Votta, L.; Chiaradia, M.T.; DeMarzo, C.; Favuzzi, C.; Germinario, G.; Guerriero, L.; LaVopa, P.; Maggi, G.; Posa, F.; Selvaggi, G.; Spinelli, P.; Waldner, F.; Brenner, A.E.; Carey, D.C.; Elias, J.E.; Garbincius, P.H.; Mikenberg, G.; Polychronakos, V.A.; Meunier, R.; Cutts, D.; Dulude, R.S.; Lanou, R.E. Jr.; Massimo, J.T. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02,3130;EY-76-C-02-3000;EY-76-C-02-3069. *Phys. Rev. Lett.;* **45**: No. 3, 157-160(21 Jul 1980).

Quark structure functions have been extracted from low-p/ sub T/ inclusive hadron production data for the pion and kaon with use of the recombination model. n/sup π/=1.0 +- 0.1 and n/sup K/ =2.5 +- 0.6 is obtained, where n is the leading (1-x) power of the nonstrange—valence-quark distribution. Both the pion and kaon nonstrange—sea-quark functions have n≈3.5.

STRONG INTERACTIONS, BARYON NO.=1

34297 **Neutron oscillations and the existence of massive neutral leptons.** Kuo, T.K.; Love, S.T. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev. Lett.;* **45**: No. 2, 93-96(14 Jul 1980).

The neutron-antineutron transition which changes baryon number by two units is considered under some general assumptions. The resultant neutron oscillation time scale is found to vary as M^4, with M the unification mass scale, if there exists a neutral, massive, Majorana lepton. In this case, the oscillation time scale is comparable to the proton lifetime. However, in the presence of matter or external magnetic fields, the detection of such oscillations, at the present time, seems improbable.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 34293

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

REFER ALSO TO CITATION(S) 34300

34298 **Chiral-symmetry breakdown in large-N chromodynamics.** Coleman, S.; Witten, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 93405). DE-AC03-76SF00515. *Phys. Rev. Lett.;* **45**: No. 2, 100-102(14 Jul 1980).

Chromodynamics with n flavors of massless quarks is invariant under chiral U(n) x U(n). It is shown that in the limit of a large number of colors, under reasonable assumptions, this symmetry group must spontaneously break down to diagonal U(n).

FIELD THEORY

REFER ALSO TO CITATION(S) 34285, 34286, 34295, 34297, 34298

34299 (COO—2978-4) **Inelastic strong interactions at high energies. Annual progress report, June 1, 1978-May 31, 1979.** Suranyi, P. (Cincinnati Univ., OH (USA)). Feb 1979. Contract AS02-76ER02978. 16p. NTIS, PC A02/MF A01.

The investigation of cross section-generating classical solutions of field theories, sectons, was continued. Inclusive and semi-inclusive cross sections were shown to be expectation values of simple combinations of field operators in an auxiliary quantum field theory (cut field theory) that can be defined for an arbitrary field theory. The classical solutions that may dominate inclusive cross sections were investigated. The only space-time symmetry possible for the solutions was shown to be O(2) x O(1,1). Solutions of this symmetry generate an inclusive cross section with Feynman scaling. Secton solutions were compared with and shown to be distinct from other known classical solutions, instantons and solitons. Final results in the study of a Reggeon field theory with an internal symmetry were obtained.

34300 (DOE/ER/03992—392) **Progress report on research program in elementary particle theory, 1979-1980.** Sudarshan, E.C.G.; Ne'eman, Y. (Texas Univ., Austin (USA). Center for Particle Theory). 1980. Contract AS05-76ER03992. 98p. NTIS, PC A05/MF A01.

A qualitative description is given of research in the following areas: particle physics in relativistic astrophysics and cosmology; phenomenology of weak and electromagnetic interactions; strong interaction physics and quark-parton physics; quantum mechanics, quantum field theory, and fundamental problems; and groups, gauges, and grand unified theories. Reports on this work have already been published, or will be, when it is completed. (RWR)

34301 (FERMILAB-CONF—80/68-THY) **Nonperturbative vacuum and hard scattering processes.** Sakai, N. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1980. Contract AC02-76CH03000. 3p. (CONF-800724—21). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A number of interesting suggestions for the QCD nonperturbative vacuum have been advocated in recent years by a group of people in Copenhagen. Some of the main ideas are briefly reviewed. An attempt to obtain the physical effects of the nonperturbative vacuum by studying hard scattering processes such as $e^+e^- \rightarrow$ hadrons is also described. 2 figures.

34302 (FERMILAB-CONF—80/69) **Exact integrability in quantum field theory.** Thacker, H.B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1980. Contract AC02-76CH03000. 12p. (CONF-800674—2). NTIS, PC A02/MF A01.

From 5. workshop on current problems in high energy particle theory; Bad Honnef, F.R. Germany (2 Jun 1980).

The treatment of exactly integrable systems in various branches of two-dimensional classical and quantum physics has recently been placed in a unified framework by the development of the quantum inverse method. This method consolidates a broad range of developments in classical nonlinear wave (soliton) physics, statistical mechanics, and quantum field theory. The essential technique for analyzing exactly integrable quantum systems was invested by Bethe in 1931. The quantum-mechanical extension of the inverse scattering method and its relationship to the methods associated with Bethe's ansatz are examined here. (RWR)

34303 (LBL—8957, pp 327-353) **Vacuum structure and QCD.** Gross, D. (Princeton Univ., NJ). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

An overview of QCD is given, and some of the dynamical issues that arise in attempts to solve this theory are discussed. In particular, attention is focused on the problems that appear in attempts to discuss the structure of low-lying hadrons, e.g. nucleons, on the basis of a color gauge theory of quarks. The picture of hadronic structure developed by Callan, Dashen, and Gross is reviewed; this picture maintains that it presents the qualitative features of hadronic structure emerging in a direct way from first principles. Finally, the relevance of the emerging understanding of the structure of hadrons to the question of what hadronic matter (nuclear or quark matter) might look like at high densities is discussed. (RWR)

34304 **Does the equation of motion determine commutation relations?.** Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). EY-76-C-02-3065. *Phys. Rev., D;* **22**: No. 4, 919-923(15 Aug 1980).

Some examples in both quantum mechanics and quantum field theory are used to demonstrate the fact that a given equation of motion can have more than one inequivalent Lagrangian and hence can admit two different quantization procedures.

34305 **Operator ordering and Feynman rules in gauge theories.** Christ, N.H.; Lee, T.D. (Columbia University, New York, New York 10027). *Phys. Rev., D;* **22**: No. 4, 939-958(15 Aug 1980).

The ordering of operators in the Yang-Mills Hamiltonian is determined for the $V_0=0$ gauge and for a general noncovariant gauge chi(V/sub i/)=0, with chi a linear function of the spatial components of the gauge field V/sub μ/. We show that a Cartesian ordering of the $V_0=0$ gauge Hamiltonian defines a quantum theory equivalent to that of the usual, covariant-gauge Feynman rules. However, a straightforward change of variables reduces this $V_0=0$ gauge Hamiltonian to a chi(V/sub i/)=0 gauge Hamiltonian with an unconventional operator ordering. The resulting Hamiltonian theory, when translated into Feynman graphs, is shown to imply new nonlocal interactions, even in the familiar Coulomb gauge.

SCATTERING THEORY

REFER ALSO TO CITATION(S) 34301

34306 (CONF-800829—4) **Few-body scattering integral equation approach.** Kroeger, H.; Perne, R. (Oak Ridge National Lab., TN (USA); Bayer Chemical Co., Leverkusen (Germany, F.R.)). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

For the investigation of few-body binding energy correlations, Lippmann-Schwinger-type equations with a simple structure of kernels have been used. This note presents N-body integral

equations with simple kernel structures for the scattering of two composite particles in the incoming channel. Only the bound-state part of the subsystem Green's functions are used. This approach leads to coupled equations with kernels consisting of two-body interactions, the free Green's function, the bound-state wave function of the N-1, N-2, ..., two-body subsystem and the corresponding poles. Thus, in order to calculate an N-body t-amplitude, one must first calculate only the N-1, N-2, ..., two-body bound states and binding energies. In the low-energy region there is another advantage. If the scattering energy lies below some cluster breakup threshold, one can omit the pole corresponding to this cluster. (RWR)

34307 (CONF-800829—5) **Efimov pathology in effective two-body system.** Kroeger, H.; Perne, R. (Oak Ridge National Lab., TN (USA); Bayer Chemical Co., Leverkusen (Germany, F.R.)). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

Amado and Greenwood have shown that there is no Efimov effect for four or more particles. The present authors use an (n-1)-fold successive separable approximation (nssa) to the general n-body operator identities. They find that for the conditions considered the necessary condition for the existence of an infinite number of n-body bound levels ($n > or = 4$) is not violated. The nssa reduces the n-body to an effective two-body phase space. It is concluded that the appearance of the Efimov effect is not restricted to three-body systems. (RWR)

34308 (CONF-800829—7) **Scattering in the quasiperiodic and stochastic regimes.** Noid, D.W.; Koszykowski, M.L. (Oak Ridge National Lab., TN (USA); Sandia National Labs., Livermore, CA (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

The results of a quasiclassical investigation of the scattering process for a colinear collision between a particle and two coupled anharmonic oscillators are reported. The energy transfer was found to fall dramatically at the critical energy where the oscillators made the transition from quasiperiodic to stochastic motion.

PHYSICS RESEARCH

NUCLEAR PHYSICS

34309 (UCID—18577) **Status report to DOE Nuclear Data Committee.** Haight, R.C.; Struble, G.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

This status report from Lawrence Livermore Laboratory covers work in the areas of nuclear data applications - measurements, nuclear data application - calculations, nuclear data for reactor safety, fission physics, and data evaluation and compilation. Separate abstracts were prepared for seven of the contributions to this report. 7 figures, 3 tables. (RWR)

34310 **Recent references.** Ewbank, W.B.; Hurley, F.W.; McGinnis, M.R.; Ramavataram, S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **30**: No. 2, 171-303(Jun 1980).

References, key numbers, key words, and reaction indexing are given for all literature received by the Nuclear Data Project or assigned key numbers between January and April 1980.(AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

34311 (CONF-800829—6) **Few-body binding energy correlations.** Kroeger, H.; Perne, R. (Oak Ridge National Lab., TN (USA); Bayer Chemical Co., Leverkusen (Germany, F.R.)). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

The effect of strongly linear few-nucleon binding energy correlations under variation of the potential has been found by the authors in the three-nucleon case. Their previous work is sketched as a basis for giving several extensions in the present note. Under realistic conditions there is a weak energy dependence for the kernels of the separable approximated Alt-Grassberger-Sandhas equations. The first-order correction E/sub T/[1] is smaller for the Gauss potential than for the Yamaguchi; this result is in agreement in the t-d case and in the α-t case, as is shown. 2 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

34312 (LA-UR—80-1919) **Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{9}Be → n vector X at 800 MeV.** Riley, P.J.; Hollas, C.L.; Newsom, C.R. (Texas Univ., Austin (USA); Los Alamos Scientific Lab., NM (USA); Texas A and M Univ., College Station (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—13). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The spin transfer parameters, K/sub NN/ and K/sub LL/, have been measured in p vector d → n vector X and p vector ^{9}Be → n vector X at 0° and 800 MeV. The rather large values of K/sub LL/ demonstrate that this transfer mechanism will provide a useful source of polarized neutrons at LAMPF energies.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34321, 34346

34313 (LA—8179-MS) **Differential cross sections for p + ^{3}He scattering from 19.5 to 47.5 MeV.** Brown, R.E.; Murdoch, B.T.; Hasell, D.K.; Sourkes, A.M.; van Oers, W.T.H. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

Differential cross sections for ^{3}He(p,p)^{3}He elastic scattering have been measured at 11 energies from 19.5 to 47.5 MeV. The most forward center-of-mass angle for the angular distributions varies from 10.1 to 13.4°, and the most backward angle varies from 163.2 to 173.4°. The relative errors are usually less than 2%, and the scale error is 1.5%. The present data and the existing vector-analyzing power and total-reaction cross-section data are being analyzed in this energy range using the Los Alamos Scientific Laboratory R-matrix code EDA.

34314 (UCID—18577, pp 1,2) **Neutron total cross section for tritium.** Phyllips, T.W.; Berman, B.L.; Seagrave, J.D. (Los Alamos Scientific Lab., NM). 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

The neutron total cross sections for tritium was measured for incident neutron energies ranging from 60 keV to 80 MeV with an experimental accuracy of better than 0.5% over much of this energy range. The extrapolated zero-energy cross section was found to be 1.70 +- 0.03 b. A minimum in the cross section near 600 keV (with a rise at lower energy) was newly observed. The cross section in the region between 7 and 14 MeV exhibits no structure; this result contradicts the existence of a bound four-neutron state. 1 figure. (RWR)

34315 **Measurement of p+d→^{3}He+γ and comparison with the inverse reaction.** Nefkens, B.M.K.; Bauer, T.S.; Baba, K.; Boudard, A.; Briscoe, W.J.; Bruge, G.; Faure, J.L.; Gosset, J.; Hegerath, A.; Lugol, J.C.; Silverman, B.H.; Terrien, Y. (Departement de Physique Nucleaire: Moyenne Energie, Centre d'Etudes Nucleaires de Saclay, 91190 Gif-sur-Yvette, France). *Phys. Rev. Lett.;* **45**: No. 3, 168-172(21 Jul 1980).

Seven differential cross sections of the reaction p+d→^{3}He+γ have been measured at T/sub p/=450 and 550 MeV between 52° and 92° (θ/sub γ/ c.m.). ^{3}He's were analyzed by the SPES I spectrometer in coincidence with photons detected by Cerenkov counters. The results are about twice the cross sections of the inverse reaction measured recently by Hegerath et al. and by Argan et al. The data are consistent, however, with the γ+^{3}Hearrow-right-leftp+d data of Heusch et al.

34316 **Analysis of ^{3}He + ^{4}He elastic scattering between 18 and 70 MeV with the resonating group method of Brown and Tang.** Bacher, A.D.; Conzett, H.E.; de Swiniarski, R.; Resmini, F.G.; Tombrello, T.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Helv. Phys. Acta;* **51**: No. 5-6, 680-684(31 Jul 1979).

Differential cross-sections for the elastic scattering of ^{3}He from a ^{4}He gas target have been measured at 44 energies between 18 and 70 MeV for center of mass angles between 18° and 160°. These measurements cover a range of excitation in ^{7}Be between 11.8 and 41.5 MeV. In this region the authors observe marked changes in the shapes of the angular distributions. A phase-shift analysis was performed and the results were compared to the resonating-group calculations of Brown and Tang.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34352, 34364

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34364

34317 Nucleus-nucleus total reaction cross sections. DeVries, R.M.; Peng, J.C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **22**: No. 3, 1055-1064(Sep 1980).

We compare σ/sub R/(E) for nucleus-nucleus systems (obtained from existing direct measurements and derived from elastic scattering data) with nucleon-nucleon and nucleon-nucleus data. The energy dependence of σ/sub R/(E) for nucleus-nucleus systems is found to be quite rapid; there appears to be no evidence for an energy independent, geometric σ/sub R/. Simple parameter free microscopic calculations are able to quantitatively reproduce the data and thus, emphasize the dominance of nucleon-nucleon interactions in medium energy nucleus-nucleus collisions.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

34318 Isospin quintets in the 1p and s-d shells. Burleson, G.R.; Blanpied, G.S.; Daw, G.H.; Viescas, A.J.; Morris, C.L.; Thiessen, H.A.; Greene, S.J.; Braithwaite, W.J.; Cottingame, W.B.; Holtkamp, D.B.; Moore, I.B.; Moore, C.F. (New Mexico State University, Las Cruces, New Mexico 88003). *Phys. Rev., C;* **22**: No. 3, 1180-1183(Sep 1980).

The pion double-charge exchange reaction (π^+,π^-) has been used to measure the ground-state masses of ^{12}O, ^{16}Ne, ^{24}Si, and ^{32}Ar. The mass excesses were found to be 32.059(48), 24.051(45), 10.682(52), and -2.181(50) MeV, respectively. These are the first reported measurements of the masses of ^{24}Si and ^{32}Ar and the values for ^{12}O and ^{16}Ne are improved over previous results. Good agreement with the isobaric multiplet mass equation M=a+bT/sub z/ +cT/sub z/ ^{2} is obtained for the known members of all four quintets.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34082, 34312, 34318, 34342, 34346

34319 (LA-UR—80-2427) **Polarization transfer in inelastic scattering.** Moss, J.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-800824—20). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

Polarization transfer experiments are now feasible for inelastic scattering experiments on complex nuclei. Experiments thus far have dealt with the spin-flip probability; this observable is sensitive to the action of spin-spin and tensor forces in inelastic scattering. Spin-flip probabilities at E ~ 40 MeV in isoscalar transitions in ^{12}C(12.71 MeV) and ^{15}O(8.89 MeV) show considerable deviation from DWBA-shell model predictions; this deviation indicates evidence for more complex reaction mechanisms. Experiments at intermediate energies will soon be possible and will yield data of much higher precision than is possible at lower (E < 100 MeV) energies. These experiments hold exciting promise in such areas as nuclear critical opalescence. 7 figures, 1 table.

34320 (LBL—8957, pp 1-62) **Coherent processes and multiparticle production in hadron-nucleus collisions at high energies.** Ferbel. T. (Univ. of Rochester, NY). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Basic phenomenology and currently available data on inclusive particle production and coherent inelastic processes on nuclar targets at energies of several hundred GeV are reviewed. 26 figures, 1 table.

34321 (LBL—8957, pp 195-239) **Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions.** Frisch, H. (Univ. of Chicago, IL). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Three types of hadron-nucleus experiments are described: single-particle production at large values of transverse momentum, large-mass hadron pair production, and large-mass dimuon production. Yields from experiments are plotted and parametrized. The following conclusions are drawn: the single-particle high-p/sub/T production data show a 'collective effect' - for p-bar production a tungsten nucleus has the equivalent cross section of 1500 independent nucleons; the double-arm data seem inconsistent; the dimon production data are consistent with an atomic weight dependence of A/sup 1.0/ after an initial rise in the exponent at low mass. 23 figures, 3 tables. (RWR)

34322 Nonstatistical effects in the ^{12}C(^{15}N,α) reaction. Ortiz, M.E.; Andrade, E.; Cardenas, M.; Dacal, A.; Menchaca-Rocha, A.; Ford, J.L.C. Jr.; del Campo, J.G.; Robinson, R.L.; Shapira, D.; Aguilera, E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **22**: No. 3, 1104-1120(Sep 1980).

States in ^{23}Na were populated using the ^{12}C(^{15}N,α) reaction. Excitation functions were measured in the energy range E/sub c.m./ =9.51—17.33 MeV for 41 states in ^{23}Na from 0 to 12.2 MeV in excitation energy. Angular distributions were measured at selected energies between about 2° and 110° (c.m.). A large number of correlated resonantlike structures with ~400 keV (c.m.) widths were observed in addition to statistical fluctuations in the ^{12}C(^{15}N,α) data. Forward peaking of the on-resonant angular distributions appear to be a signature of the excitation of high-spin states in the compound nucleus. Elastic scattering excitation functions measured at backward angles show structures which are not well correlated with the anomalies seen in the reaction channels. The ^{12}C(^{15}N,α) data suggest that the resonant portion of the cross sections can be attributed to the population of high-spin levels close to the yrast line of the compound nucleus.

34323 Gamow-Teller sum rules and the ^{14}C(^{6}Li,^{6}He)^{14}Nreaction. Wharton, W.R.; Goodman, C.D.; Hensley, D.C. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., C;* **22**: No. 3, 1138-1144(Sep 1980).

A correlation between the (^{6}Li,^{6}He) cross sections and the Gamow-Teller strength observed previously for other targets persists in the ^{14}C(^{6}Li,^{6}He)^{14}Nreaction. The total Gamow-Teller strength up to 12 MeV excitation is measured and we derive sum rules for the Gamow-Teller strength which depend on the LS configurations of the target state. The extracted LS configuration of the ^{14}C ground state is in serious disagreement with shell model calculations. There are several inconsistencies within our understanding of the nuclear structure and transition strengths in these nuclei, part of which is attributable to mesonic currents. Constraints are also placed upon the (^{6}Li,^{6}He) reaction mechanism.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34324

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34361

34324 Non-statistical effects in neutron reactions on ^{32}S. Halderson, D. (Florida State Univ., Tallahassee (USA). Dept. of Physics); Castel, B. (Oak Ridge National Lab., TN (USA)); Aizer, G. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics). *J. Phys., G (London);* **6**: No. 1, 59-67(Jan 1980).

A simple procedure extending bound-state calculations into the continuum is presented. With shell-model parameters fixed by the bound-state calculation the model describes resonances in the ^{32}S(n,γ) reaction as positive- and negative-parity states embedded in the continuum. Agreement with recent data is satisfactory enough to assign theoretical configurations to the doorway states of specific groups of resonances.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 34318

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34322

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34318, 34320, 34342

34325 (LA-UR—80-1925) **Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV.** Hardekopf, R.A.; Brown, R.E.; Correll, F.D.; Ohlsen, G.G. (Los Alamos Scientific Lab., NM (USA); Indiana Univ., Bloomington (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—10). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

Differential-cross-section and analyzing-power angular distributions were measured for 17 MeV tritons elastically scattered from targets of ^{26}Mg, ^{27}Al, and ^{28}Si in the angular range 20 to 160^0. The experiment was performed at the Los Alamos Scientific Laboratory Van de Graaff facility using the Lamb-shift polarized triton source and the supercube scattering chamber. A pair of detector telescopes with angular resolutions of +-0.4^0 detected the reaction products, with mass identification and storage performed by an on-line computer. The triton beam intensity available at the target was about 70 nA with a polarization of 0.77. The target thicknesses were about 3 mg/cm^2, although thinner targets were used for the ^{27}Al forward-angle data.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

REFER ALSO TO CITATION(S) 34317, 34361

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34326

NUCLEAR REACTIONS AND SCATTERING

34326 **Comparison of the single-proton pickup reactions ^{40}Ca(^{11}B,^{12}C)^{39}Kand ^{40}Ca(^{13}C,^{14}N)^{39}Kat low and high bombarding energies.** Maguire, C.F.; Bomar, G.L.; Ramayya, A.V.; Piercey, R.B.; Ford, J.L.C. Jr.; del Campo, J.G.; Shapira, D.; Hensley, D. (Physics Department, Vanderbilt University, Nashville, Tennessee 37235). *Phys. Rev., C;* **22**: No. 3, 1097-1103(Sep 1980).

The single-proton pickup reactions ^{40}Ca(^{11}B,^{12}C)^{39}Kand ^{40}Ca(^{13}C,^{14}N)^{39}Kare found to produce qualitatively different angular distributions when compared at similar bombarding energies. The surface transparent potential invoked to explain the forward rise in the ^{40}Ca(^{13}C,^{14}N)^{39}Kdifferential cross section at 40 MeV is shown to be inappropriate for the ^{40}Ca(^{11}B,^{12}C)^{39}Kdata analysis at 32 MeV incident energy. For the higher energy measurements at 68 MeV, both systems produce oscillatory angular distributions, but in the former case the distorted-wave Born approximation prediction is out of phase with the data, while in the latter it is exactly in phase with the data. The success of the distorted-wave Born approximation in predicting the magnitude of the cross sections is also different in the two cases.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

34327 **High-spin states and band structure in ^{76}Se.** Wells, J.C. Jr.; Robinson, R.L.; Kim, H.J.; Sayer, R.O.; Piercey, R.B.; Ramayya, A.V.; Hamilton, J.H.; Maguire, C.F. (Physics Department, Tennessee Technological University, Cookeville, Tennessee 38501). *Phys. Rev., C;* **22**: No. 3, 1126-1137(Sep 1980).

High-spin states of ^{76}Se have been investigated through observations of γ rays produced in the ^{71}Ga(^{7}Li,2n) reaction by bombarding an enriched ^{71}Ga target with 15- to 22-MeV ^{7}Li ions. Measurements were made of γ-ray singles and γ-γ coincidence spectra, excitation functions, γ-ray angular distributions, γ-γ angular correlations, and Doppler broadening of photopeaks. Level energies, decay modes, spins and parities, γ-ray branching ratios, γ-ray radiative admixtures, and lifetimes were deduced. There is evidence for a strongly excited quasirotational band with the highest member observed being a 12$^+$ state at 5432 keV, for an odd-parity band built on a 5$^-$ state, and for a $\Delta J=1$ band which has the characteristics of a γ-vibrational band in a deformed nucleus. Interacting boson approximation model calculations are compared with the experimental results.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34250, 34320, 34327, 34342

34328 (LA-UR—80-1977) **The (t,d) reaction on the Ni isotopes with polarized tritons.** Flynn, E.R.; Cizewski, J.A.; Brown, R.E.; Hardekopf, R.A.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—15). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The (t vector,d) reaction has been measured on targets of ^{58,60,62,64}Ni with 17 MeV polarized tritons. Spectroscopic factors, angular momentum and total spin transfer were obtained from the differential cross section and A/sub y/ values of levels up to 3.5 MeV in excitation energy. The present (t,d) measurement enables a better description of the 9/2$^+$ and 5/2$^+$ states which show significant shell crossing effects as a function of increasing neutron number.

34329 (UCID—18577, pp 3-4) **Measurements of ^{88}Sr(p,n) to the ground state and low-lying excited states of ^{88}Y.** Grimes, S.M.; Poppe, C.H.; Wong, C. 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

The (p,n) cross section on ^{88}Sr was measured for proton energies between 5.75 and 11 MeV. Overall resolution was sufficient to separate the ^{88}Y ground state (J/sup π/ = 4$^-$), the first excited state (J/sup π/ = 5$^-$) at 0.232 MeV, and the second excited state (J/sup π/ = 1$^+$) at 0.393 MeV. A Legendre polynomial fit was made to the angular distributions and the resulting integrated cross sections are shown. 1 figure. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

34330 (ANL/PHY—79-4, pp 565-569) **Yrast spectra of ^{146}Gd, ^{147}Gd and ^{152}Dy in the deformed independent particle model.** Neergard, K.; Dossing, T.; Matsuyanagi, K. (Niels Bohr Inst., Copenhagen, Denmark). Oct 1979.

From Symposium on high spin phenomena in nuclei; Argonne, IL, USA (15 Mar 1979).

Calculation of the yrast spectrum of a nucleus by use of empirical single-particle energies is discussed. Consequences of using a larger than usual average pairing gap in Strutinsky calculations are shown for a few levels in ^{146}Gd, ^{147}Gd, and ^{152}Dy. 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34317

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

34331 (UCID—18577, pp 17-18) **Determination of properties of short-lived fission products.** Meyer, P.; Henry; Lien. 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

Detailed experiments aimed at the determination of absolute intensities of γ rays associated with the antimony fission products were completed. Of particular importance is ^{133}Sb, in which there is the unexpectedly large population of the daughter ^{133}Te isomer. Of the γ rays observed in the ^{133}Sb decay, those with intensities of five percent or greater are tabulated. 1 table. (RWR)

34332 **Decay of ^{146}Tb and the lowest 2$^+$ state in ^{146}Gd.** Toth, K.S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **22**: No. 3, 1341-1343(Sep 1980).

A recent in-beam study indicates that the first-excited state in the N=82 nucleus, ^{146}Gd, is 3$^-$, rather than 2$^+$ as systematics had indicated. A subsequent investigation, which utilized ^{144}Sm(α,2nγ) excitation function measurements, has provided evidence that the lowest 2$^+$ state in ^{146}Gd lies at 1971 keV, about 392 keV above the 3$^-$ level. It seems therefore that, as in the case of ^{16}O, ^{40}Ca, and ^{208}Pb where the first-excited states are not 2$^+$, ^{146}Gd may have a doubly closed-shell structure. Previously, we investigated levels in ^{146}Gd populated in the decay of 23-s ^{146}Tb. Data from these decay studies were reexamined, and a weak 1971.8-keV γ ray was observed to follow the decay of ^{146}Tb. This transition most probably deexcites the 2$^+$ ^{146}Gd level seen in the ^{144}Sm(α,2nγ) reaction. In the light of the newly available information, a modified ^{146}Tb decay scheme is presented and discussed.

34333 **Gamma-ray emission probabilities and half-life of ^{139}Ba.** Gehrke, R.J. (Idaho National Engineering Lab., Idaho Falls (USA)). *Int. J. Appl. Radiat. Isot.;* **31**: No. 1, 37-40(Jan 1980).

The emission probability of the 165- and 1420-keV γ-rays emitted in the decay of ^{139}Ba has been measured by 4π β-γ coinci-

dence counting and Ge(Li) spectrometric techniques to be (23.76 +- 0.25) and (0.261 +- 0.005) γ-rays per 100 disintegrations, respectively. The half-life of ^{139}Ba has been determined to be (83.06 +- 0.28) minutes.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34332

34334 Single-proton states in ^{149}Pm. Straume, O.; Loevhoeiden, G. (Bergen Univ. (Norway)); Burke, D.G. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.); Flynn, E.R.; Sunier, J.W. (Los Alamos Scientific Lab., NM . *Z. Phys., A;* **293**: No. 1, 75-83(1979).

The ^{150}Sm(t,α)^{149}Pm reation was studied using 17 MeV polarized tritons from the tandem Van de Graaff accelerator at the Los Almos Scientific Laboratory. The alpha particles were analyzed using a Q3D magnetic spectrometer and detected with a helical-cathode position-sensitive counter. The overall resolution was approx. 25 keV FWHM. In the present study many of the previous spin assignments have been confirmed, and some ambiguities in earlier studies have been resolved. The important levels at 416 and 751 keV that are strongly populated in the stripping reactions are shown to be 3/2$^+$. Also new fragments of the g/sub 7/2/ and d/sub 3/2/ shell model states have been located. The deduced spectroscopic factors are compared to those measured in other promethium isotopes. It was found that the total (t,αt) strength of the assigned peaks is stable within 15% for the chain of promethium isotopes ranging from mass number 147 to 153.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34332, 34342, 34346

34335 (UCID—18577, pp 5-6) **Studies of (n, charged particle) reactions with 14 to 15 MeV neutrons.** Haight, R.C.; Grimes, S.M.; Barschall. (Univ. of Wisconsin, Madison). 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

The spectrum of protons emitted at 90° from ^{94}Mo under bombardment with 15-MeV neutrons is shown. 1 figure. (RWR)

34336 Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions. Logan, D.; Delagrange, H.; Rivet, M.F.; Rajagopalan, M.; Alexander, J.M.; Kaplan, M.; Zisman, M.S.; Duek, E. (Department of Chemistry, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., C;* **22**: No. 3, 1080-1096(Sep 1980).

Charged-particle emission was studied for the reactions 222, 274, and 340 MeV ^{40}Ar+^{116}Sn, ^{154}Sm, ^{164}Dy, and ^{197}Au. Energy and angular distributions were measured for H and ^{4}He and angular distributions for Li, Be, B, C, N, and O, fissionlike fragments and evaporation residues. For H and He the data are consistent with a low-temperature evaporative component and a high-temperature forward peaked component. For Li through O the forward-peaked emission was studied for 340 MeV ^{40}Ar only. The evaporation residue cross sections decrease strongly with increasing Z reflecting the increasing fissionability. However, the cross sections for ^{1}H and ^{4}He in coincidence with fission are essentially constant with Z. Coincidence measurements, energy spectra, and ^{4}He/^{1}H ratios indicate that most H/He evaporation precedes fission. This implies that the energy thermalization is very rapid indeed and that the light particle spectra can probe the very early history of the composite systems.

34337 Fast-neutron total and scattering cross sections of ^{16,17}Ag in the MeV region. Smith, A.; Guenther, P.; Winkler, G.; Whalen, J. (Argonne National Lab., IL (USA)). *Nucl. Phys., A;* **332**: No. 3/4, 297-316(Dec 1979).

Neutron total cross sections are measured from 0.25 to 4.5 MeV at intervals of 2 10 keV. Neutron differential elastic- and inelastic-scattering cross sections are measured from 15 to 40 MeV at intervals of <= 0.2 MeV. Cross sections for scattering into more than 20 energy groups are determined. Cross sections calculated from an optical-statistical model are in quantitative agreement with measured neutron total and elastic-scattering cross sections and in qualitative agreement with measured neutron inelastic-scattering cross sections. In the context of this model, significant dependence of the inelastic-scattering process on parity and/or deformation is not in evidence. The interpretation of the observed neutron inelastic neutron scattering results is consistent with previous reported J/sup π/ assignments and the systematics of nuclear level densities.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34330

34338 Rotational energy expressions and least-squares fitting of backbenders and similar nuclei. Rasmussen, J.O. (California Univ., Berkeley (USA). Dept. of Chemistry; California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Guidry, M.W. (Tennessee Univ., Knoxville (USA). Dept. of Physics); Ward, T.E. (Indiana Univ., Bloomington . *Nucl. Phys., A;* **332**: No. 1/2, 82-94(Dec 1979).

The backbending or irregularities of band spacings of states near the yrast line were fit using simple rotational energy expressions which include band mixing of the yrast and yrare states. In our model the sharp backbending requires two large mixing terms, a spin-independent term arising from the pairing interaction and a Coriolis coupling term. Least-squares fitting of backbenders in the deformed even-even nuclei indicate a near cancellation of the mixing matrix elements near the virtual band crossing. Although the idealized and simplified expressions for the backbending spin in terms of the pairing gap Δ, high-j orbital spacing, high-j Coriolis matrix element J_1, and moment of inertia I may not be quantitatively correct, they do indicate the general conditions required for backbending.

34339 Bandcrossing in K unequal 0 bands. Peker, L.K. (Amsterdam Univ. (Netherlands). Natuurkundig Lab.; Brookhaven National Lab., Upton, NY (USA). National Nuclear Data Center); Rasmussen, J.O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California State Coll., Los Angeles (USA)). *Z. Phys., A;* **292**: No. 3, 271-273(1979).

It is shown that in the crossing of two bands with K not = 0 in deformed nuclei, two new effects are observed that are not seen in the crossing of K = 0 bands; namely, a) I/sub critical/ at which the bands cross is lowered and b) band crossing occurs at different values of I/sub crit/ for odd I(or 1 + 1/2 in odd A) and even I(or I + 1/2). These predictions are shown to be observed in the odd-A rare-earth nuclei where data are available to high spin.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34351

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

34340 Correlation studies of rotational behavior at very high angular momentum. Deleplanque, M.A.; Stephens, F.S.; Andersen, O.; Garrett, J.D.; Herskind, B.; Diamond, R.M.; Ellegaard, C.; Fossan, D.B.; Hillis, D.L.; Kluge, H.; Neiman, M.; Roulet, C.P.; Shih, S.; Simon, R.S. (The Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark). *Phys. Rev. Lett.;* **45**: No. 3, 172-175(21 Jul 1980).

Transition-energy correlations are studied in rotational erbium nuclei up to 1250 keV. A collective moment of inertia J/sub c/ corresponding to in-band transitions is directly deduced from the data and compared to the effective moment of inertia, J/sub eff/, deduced from multiplicity measurements. For I~(30—45)ħ it is found that J/sub c/ is 25—50% smaller than J/sub eff/, which suggests an important contribution to the total spin from a few aligned particles. This description implies band crossings for which there is independent evidence.

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 34340

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34321, 34334, 34336

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 34317, 34351

ENERGY LEVELS AND TRANSITIONS

34341 Suppression of the transverse scattering amplitude in ^{207}Pb. Papanicolas, C.N.; Lichtenstadt, J.; Sargent, C.P.; Heisenberg, J.; McCarthy, J.S. (Bates Linear Accelerator Center, Laboratory for Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069;DE-A502-79ER10338;DE-A505-7804861. *Phys. Rev. Lett.;* **45**: No. 2, 106-110(14 Jul 1980).

Transverse form factors have been extracted for the low-lying neutron hole (particle) states of ^{207}Pb from inelastic-electron-scattering data. A systematic, multipolarity-and momentum-transfer-independent quenching of ~55% in the transverse amplitude is observed when compared with single particle predictions for both electric and magnetic transitions. The magnitude of the observed effect is not readily explained by our present theoretical understanding of this nucleus.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34320, 34321, 34336, 34341

34342 (LBL—8957, pp 115-138) **Multiplicity correlations in high-energy hadron-nucleus collisions.** Faessler, M.A. (Max-Planck-Inst. fuer Kernphysik, Heidelberg, Germany). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Inelastic hadron-nucleus interactions were measured at incoming momenta of 20 and 37 GeV/c at the CERN SPS. Angular and multiplicity distributions of relativistic particles were studied for different target nuclei and as a function of the multiplicity of knock-out nucleons. Possible implications of the experimental findings for theoretical models are discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

34343 Search of new elements. Plans and perspectives. Seaborg, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Usp. Khim.;* **48**: No. 6, 1015-1026(Jun 1979). (In Russian).

From Nobel symposium on superheavy elements; Ronneby, Sweden (11 Jun 1974).

Search of new elements (superheavy elements, in particular) is discussed based on irradiation of heavy element targets by ions of other heavy elements with further product identification by physical or chemical methods. Chemical properties of superheavy elements are predicted based on calculated electronic structures, periodic table and chemical theories verified many times. Predictions of chemical properties of superheavy elements make it possible to plan experiments on their synthesis by heavy ion bombardment with further chemical product identification.

RADIOACTIVE DECAY

34344 Gamma rays following alpha decay of ^{245}Cm and the level structure of ^{241}Pu. Dickens, J.K.; McConnell, J.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., C;* **22**: No. 3, 1344-1347(Sep 1980).

Relative intensities for K x rays and gamma rays emanating from ^{245}Cm have been measured using several Ge photon detectors. The absolute intensity for the dominant 175-keV gamma ray in ^{241}Pu was determined to be 9.5 photons per 100 ^{245}Cm alpha decays with an uncertainty of +- 7%. Eleven gamma rays have been placed as transitions among levels in ^{241}Pu.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34344

34345 Low-spin states of ^{250}Cf populated in the electron capture decay of 2.22-h ^{250}Es. Ahmad, I.; Sjoblom, R.K. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., C;* **22**: No. 3, 1226-1232(Sep 1980).

Low-spin states of ^{250}Cf have been investigated by measuring γ rays and conversion electrons associated with the electron capture decay of 2.22-h ^{250}Es. Mass-separated ^{250}Es samples produced by the ^{249}Cf(d,n) reaction were used for these measurements. The γ-ray spectra were measured with a 25-cm^3 coaxial Ge(Li) spectrometer and the electron spectra were measured with a cooled Si(Li) detector. Multipolarities of intense transitions in ^{250}Cf were deduced and logft values of electron capture transitions were derived from measured electron capture intensities. On the basis of the results of the present investigation the following bandheads were identified in ^{250}Cf: E (keV),K,Iπ = 871.6, 2,2-; 1031.9, 2,2+; 1154.2, 0,0+; 1175.5, 1,1-; 1210.0, 2,2-; 1244.4, 2,2+; 1266.5, 0,0+; and 1658.1, 2,2+. The 2.22-h state in ^{250}Es has been given a spin-parity assignment of 1- with configuration {n[734]9/2-; p[633]7/2+}1/sub -/.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34345

34346 (LA—8394-MS) Graphs of the cross sections in the Alternate Monte Carlo Cross Section library at the Los Alamos Scientific Laboratory. Seamon, R.E.; Soran, P.D. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

Graphs of all neutron cross sections and photon production cross sections on the Alternate Monte Carlo Cross Section (AMCCS) library have been plotted along with local neutron heating numbers. The values of ν-bar, the average number of neutrons per fission, are also plotted for appropriate isotopes.

SPONTANEOUS AND INDUCED FISSION

34347 (UCID—18577, pp 12-13) Fission cross section of ^{245}Cm. White; Browne; Howe; Landrum. 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

The neutron-induced fission cross section of ^{245}Cm was measured from 0.001 eV to 20 MeV. The data were analyzed in the resonance region with a multichannel R-matrix code with least-squares fitting capability. Preliminary resonance parameters were obtained for levels below 32 eV. Fits to the ^{245}Cm fission data from 10 eV to 32 eV are shown; the average fission width is 550 MeV, and the neutron strength function, 1.02 x 10^{-4}. 1 figure. (RWR)

34348 (UCID—18577, pp 12, 13-14) Fission neutron multiplicities for ^{245}Cm, ^{232}Th, and /sup 242m/Am(n,f) reactions. Howe; Browne; White; Dupzyk; Landrum; Dougan. 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

The fission neutron multiplicity of /sup 242m/Am is shown from 0 to 30 MeV, along with results of a bivarant-weighted least-squares fit. 1 figure. (RWR)

34349 (UCID—18577, pp 19-20) Time dependent beta-delayed neutrons from fissioning systems. Waldo; Karam; Meyer, P. 13 Mar 1980.

In Status report to DOE Nuclear Data Committee.

A ^{3}He ionization chamber was used in a computer-controlled rapid rabbit transit system to measure the time-dependent β-delayed neutron yields. The time-dependent gross neutron counts were analyzed in a least-squares manner to obtain a few group analysis. Gross β-delayed neutron yields (relative to ^{235}U) were obtained for ^{232}Th, ^{232}U, ^{233}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, /sup 242m/Am, ^{245}Cm, and ^{249}Cf. These data were compared with results calculated with a simple model. 1 table. (RWR)

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 34295

34350 Generalized Fermi sea for plane-wave Hartree-Fock theory. III. Semirealistic interactions in three dimensions. Aguilera-Navarro, V.C.; Belehrad, R.; de Llano, M.; Sandel, M.; Vary, J.P.; Rojo, O. (Instituto de Fisica Teorica, Sao Paulo 01405, Brazil). *Phys. Rev., C;* **22**: No. 3, 1260-1266(Sep 1980).

The possibility of abnormally occupying plane-wave Hartree-Fock determinants is studied analytically for several many-fermion systems interacting with short- and long-ranged pair potentials in three dimensions. Lower energy states are found in some cases, but they always depend sensitively on the shape of the potential as well as on the amount of space exchange present in the interaction.

34351 Current densities in the projected Hartree-Fock approach. II. Transverse form factors. de Guerra, E.M.; Kowalski, S. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069. *Phys. Rev., C;* **22**: No. 3, 1308-1322(Sep 1980).

Collective and single-particle contributions to transverse form factors of rotational nuclei have been computed in the projected Hartree-Fock approach using the density matrix expansion effective Hamiltonian. Results on several odd-A rare earth nuclei (^{181}Ta, ^{165}Ho, ^{159}Tb) are presented and compared to the available experimental data. Theoretical predictions for transverse electric form factors of ^{166}Er are also presented. A comparison is made of the resulting form factors as q → 0 with those extracted from measured transition probabilities B(E(M)λ; I/sub i/ → I/sub f/).

34352 Selection rule for E1 transitions. Millener, D.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **22**: No. 3, 1355-1356(Sep 1980).

It is pointed out that an often used model selection rule for E1 transitions in light nuclei is invalid. Some aspects of observed E1 transition strengths in light nuclei are discussed.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 34350, 34358

34353 Asymptotic freedom and dense baryonic matter. Morley, P.D. (Iowa State Univ. of Science and Technology, Ames (USA)); Kislinger, M.B. (Chicago Univ., IL ((USA). Enrico Fermi Inst.). *Nuovo Cim., A;* **50**: No. 4, 515-522(21 Apr 1979).

By use of the temperature (T) dependent equation of state (EOS) of quantum chromodynamics, presented here, for a density $>10^{15}$ g/cm^3 and various EOS in the literature for density $<10^{15}$ g/cm^3, M/sub D/ (assuming adiabatic motion and uniform density), the maximum mass saved by hydrodynamic bounce from complete gravitational collapse, is calculated. If T < or approximately = 35 MeV, then M/sub D/ <= 1.50 M/sub sun/.

NUCLEAR REACTIONS AND SCATTERING

34354 (LA-UR—80-2496) **Self-consistent theory of hadron-nucleus scattering. Application to pion physics.** Johnson, M.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 52p. NTIS, PC A04/MF A01.

The requirement of using self-consistent amplitudes to evaluate microscopically the scattering of strongly interacting particles from nuclei is developed. Application of the idea to a simple model of pion-nucleus scattering is made. Numerical results indicate that the expansion of the optical potential converges when evaluated in terms of fully self-consistent quantities. A comparison of the results to a recent determination of the spreading interaction in the phenomenological isobar-hole model shows that the theory accounts for the sign and magnitude of the real and imaginary part of the spreading interaction with no adjusted parameters. The self-consistnt theory has a strong density dependence, and the consequences of this for pion-nucleus scattering are discussed. 18 figures, 1 table.

34355 (LBL—8957) **First workshop on ultra-relativistic nuclear collisions.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 540p. (CONF-7905107—). NTIS, PC A23/MF A01.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

A separate abstract was prepared for each of the 12 papers in this report. (RWR)

34356 (LBL—8957, pp 63-113) **Quark model and high-energy nuclear experiments.** Bialas, A. (Fermi National Accelerator Lab., Batavia, IL). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Theoretical aspects of the measurements of production of low-transverse-momentum secondaries in high-energy hadron-nucleus and nucleus-nucleus collisions are discussed. Applications of the quark model to those processes are discussed in some detail. 14 figures.

34357 (LBL—8957, pp 261-279) **Nuclear physics perspectives on high-energy nuclear collisions.** Feshback, H. (Massachusetts Inst. of Tech., Cambridge). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Aspects of kinetics in the collision of ultrarelativistic heavy ions with nuclei are considered. First, the prediction of heavy-ion reactions in terms of the reactions induced by a single nucleon are addressed. The deviation of such a prediction from experiment would indicate the presence of new phenomena that are present because of the structure of the incident heavy ion. It would show that it is not possible to regard the latter as a simple collection of nucleons that happen to be traveling together. Experimental results imply that in the collision of an incident proton with a target nucleon energy and momentum are being transferred to the nuclear degrees of freedom in increasingly smaller amounts as the proton energy increases; it seems that the internal degrees of freedom of the nucleon are excited by the collision. The latter half of the paper deals with an analysis of peripheral collisions from the point of view of the Weizsaecker-Williams method. The excitation of collective modes and pion production are among the topics discussed. 4 figures, 1 table. (RWR)

34358 (LBL—8957, pp 355-417) **Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions.** Stoecker, H.; Hofmann, J.; Maruhn, J.A.; Greiner, W. (Institut fuer Theoretische Physik, Frankfurt am Main, Germany). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

The essential theoretical tools for the treatment of the dynamics of high-energy heavy-ion collisions are developed. The influence of the nuclear equation of state and the new phenomena connected with phase transitions in nuclear matter (pion condensation) are discussed. In addition the possibility of a transition from nuclear to quark matter in high-energy heavy-ion collisions is investigated. In this context exotic phenomena like strongly bound pionic states, limiting temperatures, and exotic nuclei are discussed. 47 figures, 1 table.

34359 (LBL—8957, pp 419-464) **Nuclear phenomena and the short distance structure of hadrons.** Brodsky, S.J. (Stanford Univ., CA). 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

In certain cases, nuclear corrections to hadronic phenomena depend in detail on the nature of quark and gluon interactions, as well as the effects of jet development within the nuclear medium. Applications of quantum chromodynamics to fast particle production in nuclear collisions, nuclear form factors, and shadowing in deep inelastic lepton processes are reviewed. A new approach to particle production in hadron-nucleus, nucleus-nucleus, and deep-inelastic nuclear reactions is discussed from the standpoint of a color-neutralization model. 17 figures.

34360 (LBL—11123) **Search for collective phenomena in relativistic nuclear collisions.** Gutbrod, H.H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 50p. (CONF-800709—3). NTIS, PC A03/MF A01.

From Seminar on high-energy nuclear interactions and properties of dense nuclear matter; Hakone, Japan (7 Jul 1980).

After some general introductory material, the weakness of the fireball/fire streak model is illustrated, and it is indicated that more complex models are both necessary and available. The single-particle spectra of nucleons, clusters, and pions are discussed, and then attention is focused on the fate of the target nucleus and possible evidence of collective phenomena. Finally, data on central collisions that reflect the nature of the energy flux in the target nucleus are discussed. 26 figures. (RWR)

34361 Classical-equations-of-motion calculations of high-energy heavy-ion collisions. Bodmer, A.R.; Panos, C.N.; MacKellar, A.D. (Argonne National Laboratory, Argonne, Illinois 60439 and University of Illinois at Chicago Circle, Chicago, Illinois 60680). W-31-109-ENG-38. *Phys. Rev., C;* **22**: No. 3, 1025-1054(Sep 1980).

Results are obtained with the classical-equations-of-motion approach which provides a complete microscopic, classical, description including finite-range interaction effects. Nonrelativistic classical-equations-of-motion calculations are made for equal mass projectile and target nuclei with A/sub P/=A/sub T/=20 (Ne+Ne) at laboratory energies per projectile nucleon of E/sub L/=117, 400, and 800 MeV and at 400 MeV for A/sub P/=A/sub T/=40 (Ca+Ca). A static two-body potential V/sub st/ is used which is fitted to the $\sin^2\theta$ weighted differential cross section. For A/sub P/=A/sub T/=20 we also use a scattering equivalent momentum dependent potential V/sub tr/. V/sub st/ and V/sub tr/ give identical two-body scattering but are not equivalent for many-body scattering and are used to test for finite-range interaction effects in heavy-ion collisions. The evolution of central collisions is discussed. For these multiple scattering is large. Dissipation quite generally is larger at lower energies and is appreciable during the expansion phase of central collisions.There are very appredistribLimitationsiable differences in the densities, potential energies, and distributions between V/sub st/ and V/sub tr/ during the strong interaction stage. However, the final distributions are not significantly different. For A/sub P/=A/sub T/=40 at 400 MeV a transverse peaking develops in the momentum different. Noncentral collisions show typical nonequilibrium features and for larger impact parameters the final distributions show a strong single scattering component. This is true also of the impact parameter averaged distributions. Limitations and extensions of the classical-equations-of-motion approach are discussed. In particular we propose a new kinetic equation which includes finite-range interaction effects. Relativistic classical-equations-of-motion calculations to $O(v^3/c^3)$ are briefly discussed.

SPONTANEOUS AND INDUCED FISSION

34362 Shape parametrization for liquid-drop studies. Trentalange, S.; Koonin, S.E.; Sierk, A.J. (W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125). *Phys. Rev., C;* **22**: No. 3, 1159-1167(Sep 1980).

We present a new method for defining axially symmetric shapes which is particularly appropriate for describing elongated and

multineck configurations. This shape parametrization is used to describe the static properties of incompressible, charged liquid drops. In particular, we calculate the properties of binary-fission saddle points and compare these with results using other methods. We also present the geometrical properties and normal mode analyses of the two- and three-necked saddle-point families.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 34351, 34356, 34362

34363 (LBL—8957, pp 465-532) **Critical analysis of models for high-energy hadron-nucleus interactions.** Azimov, S.A. (Physical Technical Inst., Tashkent, USSR); Gulamov, K.G.; Chernov, G.M.; Gulyamov, U.G. 1979.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Models of high-energy hadron-nucleus interactions proposed recently are critically reviewed and compared with experimental data. An attempt is made to clarify what characteristics and what regions of phase space are most crucial for different models. Some interesting points where further theoretical and experimental investigations are of importance are discussed. 89 references, 23 figures.

34364 **Centre-of-mass spuriosity in continuum shell-model calculations.** Dang, G.D. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Hautes Energies); Ramavataram, S. (Oak Ridge National Lab., TN (USA)). *J. Phys., G (London);* **6**: No. 1, 47-57(Jan 1980).

A method proposed previously to eliminate the centre-of-mass (CM) spuriosity in continuum shell-model (SM) calculations of ^{4}He, is generalised to adapt to the cases of heavier nuclei. It is applied to study the (p, p) and (p, n) reactions involving the one-particle-one-hole excitation of the dipole resonances in ^{12}C and ^{16}O. The effect is non-negligible and the results show features not observed previously. The Pauli term is also studied and is found to be less important in ^{16}O as compared with the lighter nucleus ^{12}C.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

34365 (UCRL—84259(Rev.1)) **Influence of propagation on off-resonant molecular excitation.** Eberly, J.H.; Konopnicki, M.J.; Shore, B.W. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 8p. (CONF-8004106—1(Rev.1)). NITS, PC A02/MF A01.

From International quantum electronics conference; Boston, MA, USA (23 Apr 1980).

The proposal of Makarov, Cantrell, and Louisell regarding stimulated inelastic resonance fluorescence (SIRF) is shown to not accurately represent the effects of propagation on off-resonant excitation of two-level model molecular absorbers.

NEUTRON INTERACTIONS WITH MATTER

34366 (LA-UR—80-1933) **Polarized targets and polarized low energy neutrons at WNR.** Delheij, P.P.J.; Morgan, G.L.; Lisowski, P.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 3p. (CONF-800824—17). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

A description of the experimental setup used at the WNR facility to study the interaction of polarized neutrons with polarized samples is given. Planned measurements of the magnetic moments of compound nuclear resonances are discussed.

MEDICAL PHYSICS

DOSIMETRY

34367 (BNL—28157) **Microdosimetric measurements for photons in a water phantom.** Varma, M.N.; Baum, J.W.; Kliauga, P.; Bond, V.P. (Brookhaven National Lab., Upton, NY (USA); Columbia Univ., New York (USA). Radiological Research Lab.). 1980. Contract AC02-76CH00016. 23p. (CONF-800944—1). NTIS, PC A02/MF A01.

From 7. symposium on microdosimetry; Oxford, UK (8 Sep 1980).

Microdosimetric event distributions were determined in air at three primary photon energies (60, 660 and 1250 keV) and at depths of 2, 5, and 10 cm in a water phantom (30 x 30 x 30cm) from measurements of charge produced in a walled Rossi-type proportional counter. For 660 and 1250 keV photon energies free air sources of ^{137}Cs and ^{60}Co, respectively, were used at the Brookhaven National Laboratory (BNL) calibration facility and for 60 keV a 300 mCi ^{241}Am source was used. Event size spectra were taken at simulated site diameters of 0.5, 1, and 2 μm. The frequency mean (anti Y/sub F/) and dose mean (anti Y/sub D/) of lineal energy density were determined from these measurements. Our results without a phantom indicate reasonably good agreement for anti Y/sub F/ and anti Y/sub D/ with measurements reported in the literature for walled proportional counters. Ratios anti Y/sub F/(water)/anti Y/sub F/(air) and anti Y/sub D/(water)/anti Y/sub D/(air) were determined for each site diameter and depth in the phantom. For 60 keV photons the maximum increase in these ratios was approximately 8 percent for a site diameter of 2 microns at 10 cm depth in the phantom. For 660 keV photons the maximum increase in these ratios was 24 percent whereas for 1250 keV photons this maximum increase was approximately 15 percent. However, for 60 keV photons only about 8 percent increase was observed; this small increase is consistent with the fact that about half of the scattered photons are removed by photoelectric processes. Since anti Y/sub D/ in the phantom increased only by about 24 percent large changes in biological effectiveness are not expected as a function of depth in typical biological systems.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 33408, 33870, 34031, 34263

34368 (DOE/ER/01198—1311) **Characterization of internal boundary layer capacitors.** Park, H.D.; Payne, D.A. (Illinois Univ., Urbana (USA)). May 1980. Contract AC02-76ER01198. 24p. (CONF-8004105—1). NTIS, PC A02/MF A01.

From International symposium on grain boundary phenomena in electronic ceramics; Chicago, IL, USA (29 Apr 1980).

Internal boundary layer capacitors were characterized by scanning transmission electron microscopy and by microscale electrical measurements. Data are given for the chemical and physical characteristics of the individual grains and boundaries, and their associated electric and dielectric properties. Segregated internal boundary layers were identified with resistivities of 10^{12}-10^{13} Ω-cm. Bulk apparent dielectric constants were 10,000-60,000. A model is proposed to explain the dielectric behavior in terms of an equivalent n-c-i-c-n representation of ceramic microstructure, which is substantiated by capacitance-voltage analysis.

34369 (IS—4737) **FOUR: a general crystallographic Fourier program.** Powell, D.R.; Jacobson, R.A. (Ames Lab., IA (USA)). May 1980. Contract W-7405-ENG-82. 37p. NTIS, PC A03/MF A01.

FOUR computes two- and three-dimensional Patterson and electron density maps for crystallographic data with any space group symmetry. The program utilizes regular Fourier techniques for the summations in sections and down a given page. The final summation across the page is computed by use of a fast Fourier transform algorithm. A detailed description of the program together with the symbolic program listing is supplied. 1 figure.

34370 (LA-UR—80-2182) **Explosive generation of high magnetic fields in large volumes and solid state applications.** Fowler, C.M.; Caird, R.S.; Erickson, D.J.; Freeman, B.L.; Garn, W.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800936—1). NTIS, PC A02/MF A01.

From Seminar on the application of high magnetic fields in physics and semiconductors and magnetic materials; Hakone, Japan (10 Sep 1980).

Various methods of producing ultra-high magnetic fields by explosive flux compression are described. A survey is made of the kinds of high magnetic field solid state data obtained in such fields by various groups. Preliminary results are given for the magnetic phase boundary that separates the spin-flop and paramagnetic regions of MnF_2.

34371 (LA-UR—80-2372) **Muon spin rotation and other microscopic probes of spin-glass dynamics.** MacLaughlin, D.E. (California Univ., Riverside (USA). Dept. of Physics; Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800855—7). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

A number of different microscopic probe techniques have been employed to investigate the onset of the spin-glass state in dilute magnetic alloys. Among these are Moessbauer-effect spectroscopy, neutron scattering, ESR of the impurity spins, host NMR and, most recently, muon spin rotation and depolarization. Spin probes yield information on the microscopic static and dynamic behavior of the impurity spins, and give insight into both the spin freezing process and the nature of low-lying excitations in the ordered state. Microscopic probe experiments in spin glasses are surveyed, and the unique advantages of muon studies are emphasized.

34372 (SAND—79-1540C) **Electronic structure of nonstoichiometric cubic hydrides.** Switendick, A.C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 15p. (CONF-800402—15). NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

Using the supercell approach we have calculated the electronic structure of Y_4H_8, Y_4H_9, Y_4H_{11}, and Y_4H_{12} as prototypic of nonstoichiometric cubic di- and trihydrides. The nature of the interaction between the yttrium and the octahedral and tetrahedral hydrogens is shown by the relative amount of charge contained in the crystal spheres. Each added hydrogen lowers one band which was already partially filled. The charge on both the octahedral and tetrahedral sites is very similar and significantly more than is contained in a comparable atomic sphere.

34373 (SAND—80-1697C) **Kinetics of excitons, biexcitons and free carriers in Si.** Gourley, P.L.; Wolfe, J.P. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract AC04-76DP00789. 4p. (CONF-800940—1). NTIS, PC A02/MF A01.

From 15. international conference on the physics of semiconductors; Kyoto, Japan (1 Sep 1980).

Strain-confinement method was used to produce a local thermodynamic equilibrium between the various excitonic species in ultrapure Si. The steady-state and transient behavior of these particles is examined and interpreted with sets of coupled kinetic equations.

34374 **Cell-model prediction of the melting of a Lennard-Jones solid.** Holian, B.L. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B: Condens. Matter;* **22**: No. 3, 1394-1404(1 Aug 1980).

The classical free energy of the Lennard-Jones 6-12 solid is computed from a single-particle anharmonic cell model with a correction to the entropy given by the classical correlational entropy of quasiharmonic lattice dynamics. The free energy of the fluid is obtained from the Hansen-Ree analytic fit to Monte Carlo equation-of-state calculations. The resulting predictions of the solid-fluid coexistence curves by this corrected cell model of the solid are in excellent agreement with the computer experiments.

SUPERCONDUCTIVITY

GENERAL THEORY

34375 (DOE/ER/01569—149) **Effects of spin-flip scattering on the dynamics of the superconducting order parameter.** Aspen, F.E. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Jun 1980. Contract AS02-76ER01569. 179p. NTIS, PC A09/MF A01.

Thesis.

Measurements of the imaginary part of the pair-field susceptibility X″ have been carried out on dirty-limit Al-Er alloy films. Aluminum films with erbium concentrations of up to one atomic percent were incorporated as the low T/sub c/ film of an asymmetric Josephson junction. The excess current I/sub ex/ due to pair tunneling was measured as a function of the bias voltage V and of the magnetic field H, applied in the plane of the junction, at temperatures within 20% of the critical temperature T/sub c/. Comparison to theory was facilitated by noting that X″(ω,k) varies as I/sub ex/(V,H) where the frequency ω and wave-number k are related to V and H via the Josephson relations.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 33872, 33881, 33906

34376 (BNL—50973, pp 47-68) **Metallurgy and Materials Science Division.** Suenaga, M. Dec 1978.

In Annual highlights of programs in energy sciences.

The Metallurgy and Materials Science Division performs basic and applied research on the characterization of material properties and behavior under a variety of conditions; its activities also include the development of materials for applications in advanced energy systems, and support to other programs within the Department of Energy and Environment and elsewhere at the Laboratory. Currently a major effort of this Division is the investigation of superconducting properties of A15 compounds with high critical-temperature, of high critical-temperature and critical-current superconductors, and the relationship of these properties to fabrication techniques, metallurgical treatments, nonhydrostatic stresses, and irradiation with protons, neutrons, and electrons. The applications of these materials to power transmission cables and high-field magnets are studied. New programs have been started to investigate materials problems in other energy-related technologies, such as metallurgical problems in metal hydrides, high temperature fracture failures and hydrogen embrittlement of structural materials, and development of amorphous semiconductors for solar energy applications. New techniques such as energy-dispersive x-ray compositional analysis with a transmission electron microscope, small-angle neutron scattering, and extended x-ray absorption fine structure studied with synchrotron radiation will be employed as programs require them.

34377 (DOE/ER/01569—146) **Electrical analog of a Josephson junction.** Goldman, A.M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1979. Contract AS02-76ER01569. 13p. NTIS, PC A02/MF A01.

It is noted that a mathematical description of the phase-coupling of two oscillators synchronized by a phase-lock-loop under the influence of thermal white noise is analogous to that of the phase coupling of two superconductors in a Josephson junction also under the influence of noise. This analogy may be useful in studying threshold instabilities of the Josephson junction in regimes not restricted to the case of large damping. This is of interest because the behavior of the mean voltage near the threshold current can be characterized by critical exponents which resemble those exhibited by an order parameter of a continuous phase transition. As it is possible to couple a collection of oscillators together in a chain, the oscillator analogy may also be useful in exploring the dynamics and statistical mechanics of coupled junctions.

34378 (DOE/ER/01569—147) **Experimental studies in solid state and low temperature physics. Final report for 1966-1980.** Goldman, A.M.; Weyhmann, W.V.; Zimmermann, W. Jr. (Minnesota Univ., Minneapolis (USA). School of Physics). Jun 1980. Contract AS02-76ER01569. 31p. NTIS, PC A03/MF A01.

Experimental and theoretical investigations have been carried out in a broad area of low temperature and solid state physics which includes superconductivity, theory of quantum crystals (through 1973), magnetism in metals, and liquid helium. The work in superconductivity has involved investigations of the Josephson effect, studies of the pair-field susceptibility of superconductors and investigations of the thermodynamics of the superconducting phase transition. The competition between the metal-nonmetal transition and superconductivity has also been studied in random metal-rare gas systems. In the area of magnetism, magnetically ordered materials and dilute magnetic alloys have been investigated. Enhanced hyperfine nuclear magnetic ordering was discovered in $PrCu_6$ at about 2.5 mK. The research on liquid ^{4}He and ^{3}He/^{4}He mixtures has been directed at the quantum aspects of superfluid flow and rotation, the critical behavior near the lambda transition and the properties of the tricritical point. The theoretical program (through 1973) encompassed a broad spectrum of research on the properties of quantum liquids and solids with particular emphasis on crystalline ^{3}He.

34379 (LA—8446-PR) **LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980.** Maley, M.P. (comp.). (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01.

The fifteenth quarterly progress report of the Los Alamos Scientific Laboratory program to develop Nb_3Ge as a superconductor with potential applications to power transmission lines covers the period January 1-March 31, 1980. During this quarter, additional instrumentation was installed on the first 1-m Nb_3Ge cable in preparation for tests, which are now scheduled for May 1980. Three Nb_3(Ge/sub 1-x/Ga/sub x/)pseudobinary compounds were prepared with compositions approaching the proper stoichiometry and with x = 0.08, 0.12, and 0.15, respectively. The replacement of germanium by gallium causes a slight depression ($\sim$ 1.0 K) of T/sub c/ and does not appear to influence H/sub c_2/ significantly. A microscopic examination of the edge material on sections of our Nb_3Ge-clad tape revealed longitudinal cracks extending along the edges of tapes with Nb_3Ge thickness t $\geq$ 4.0 μm. Tapes with t = 3.0 μm show no evidence of such cracks, corroborating conclusions reached by ac loss measurements. The two layers of the inner conductor of the first 1-m test cable were wound with tapes coated with 4 to 6 μm of Nb_3Ge and are expected to contain longitudinal cracks. The two layers of the outer conductor of this coaxial cable were fabricated from tapes coated with $\sim$ 3.0 μm of Nb_3Ge and should exhibit lower ac losses.

34380 (LBL—10761) **A15 multifilamentary superconductors by the infiltration process.** Pickus, M.R.; Holthuis, J.T.; Rosen, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 27p. (CONF-800587—5). NTIS, PC A03/MF A01.

From International cryogenic materials conference; Upton, NY, USA (28 May 1980).

The inherent brittleness of the A15 compounds, and the requirement for a filamentary morphology, led to a heavy reliance on a powder approach for the preparation of superconducting tapes and wires. The quench-age technique, a non-powder process, was employed for the niobium-aluminum system, following the special features of the equilibrium phase diagram. The powder approach proved particularly effective for binaries, such as Nb-Sn, and for the

ternaries Nb(Al,Ge) and Nb(Al,Si). Two variations of the powder process were assessed. One involved the use of precompounded powder of the desired stoichiometry but required simultaneous application of heat and pressure. The second variation was the infiltration process. This process involves the preparation of a ductile niobium matrix containing a controlled network of interconnected pores which are subsequently infiltrated with liquid metals (Sn) or low melting-point eutectics (e.g., Al-Ge, Al-Si). The composite is then subjected to a thermomechanical treatment to form a multiply connected array of A15 filaments in a niobium matrix. Multifilamentary conductors, based on Nb_3Sn, Nb_3Al, Nb_3 (Al,Ge) and Nb_3 (Al,Si), were readily obtained. Nb_3Sn conductors made by the infiltration process exhibit a critical temperature (Tc) of 18.1 K and a critical current carrying capacity (I/sub c/) of 8 x 10^4 amp.cm^{-2} at 12 Tesla.

34381 (LBL—11055) **Fluctuation analysis.** Clarke, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 20p. (CONF-8005104—1). NTIS, PC A02/MF A01.

From International conference on superconducting quantum interference devices; Berlin, F.R. Germany (5 May 1980).

This paper briefly reviews sources of noise in Josephson junctions, and the limits they impose on the sensitivity of dc and rf SQUIDS. The results are strictly valid only for a resistively shunted junction (RSJ) with zero capacitance, but should be applicable to point contact junctions and microbridges in so far as these devices can be approximated by the RSJ model. Fluctuations arising from Nyquist noise in the resistive shunt of a single junction are discussed in the limit eI/sub o/R/k/sub B/T << 1 in which a classical treatment is appropriate, and then extend the treatment to the limit eI/sub o/R/k/sub B/T ≧ 1 in which quantum effects become important. The Nyquist limit theory is used to calculate the noise in a dc SQUID, and the results are compared with a number of practical devices. The quantum limit is briefly considered. Results for the predicted sensitivity of rf SQUIDS are presented, and also compared with a number of practical devices. Finally, the importance of l/f noise (f is the frequency) in limiting the low frequency performance of SQUIDS is discussed.

34382 **Demagnetization effects upon the lower critical field of an anisotropic type II superconductor of ellipsoidal shape.** Klemm, R.A. (Department of Physics, Simon Fraser University, Burnaby, British Columbia, Canada and Ames Laboratory: USDOE). *J. Low Temp. Phys.;* **39**: No. 5, 589-601(1 Jun 1980).

The demagnetization factors for a material with an arbitrary permeability tensor μ and with general ellipsoidal shape are found. These demagnetization factors are used to relate the bulk lower critical field H/sub c/1 in anisotropic superconductors to the angles of the external applied field. It is found that the anomalies in the angular dependence of H/sub c/1 predicted by Klemm and Clem for highly anisotropic bulk superconductors are also present for materials of highly aspherical shape. The special cases of highly oblate and prolate spheroids, corresponding to the layered and filamentary superconductors, are considered in detail.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 34300, 34304

34383 **Variable interval variable step method for the solution of linear second order coupled differential equations.** Parker, G.A.; Schmalz, T.G.; Light, J.C. (The James Franck Institute and The Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). ER-78-5-02-4908. *J. Chem. Phys.;* **73**: No. 4, 1757-1764(15 Aug 1980).

A new method for the numerical solution of the linear second order coupled differential equations of quantum scattering theory is presented. A formal framework is set up which makes clear the interrelationships between many currently used integration methods. Our variable interval variable step method is designed to reduce the total number of matrix (N^3) operations required for solution at a given accuracy. The method is tested on several problems and is shown to be uniformly and rapidly convergent, stable, and significantly faster than previous methods.

OPTICS

REFER ALSO TO CITATION(S) 34031

34384 **Nonlinear spectroscopy by multiresonant four-wave mixing.** Oudar, J.; Shen, Y.R. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., A;* **22**: No. 3, 1141-1158(Sep 1980).

Four-wave mixing processes with double and triple resonances are discussed in detail. Explicit expressions for the resonant nonlinear susceptibilities of various cases are derived. It is shown that in some cases, four-wave mixing can yield a spectrum with reduced inhomogeneous broadening. Possible applications of multiresonant four-wave mixing as a spectroscopic technique are considered. They include high-resolution spectroscopy, deduction of transition matrix elements, study of transitions between excited states, measurement of longitudinal relaxation times, distinction between resonant Raman scattering and resonant fluorescence, etc. Selective polarization arrangement allows us to suppress the nonresonant background, separately measure the real and imaginary parts of the resonant nonlinear susceptibility, minimize the effects of absorption and laser intensity fluctuations, and greatly enhance the signal-to-noise ratio.

34385 **Polydisperse-particle-size-distribution function determined from intensity profile on angularly scattered light: author's reply to comment.** Alger, T.W. (University of California, Lawrence Livermore Laboratory, P.O. Box 808, Livermore, California 94550). *Appl. Opt.;* **19**: No. 15, 2482-2483(1 Aug 1980).

The author points out that his particle-size-distribution inversion method is based on the angular intensity variation of the scattered light whereas Heintzengerg's calculation uses the spectral variation. (AIP)

34386 **Stressed mirror polishing. 1: A technique for producing nonaxisymmetric mirrors.** Lubliner, J.; Nelson, J.E. (University of California, Berkeley Laboratory, Berkeley, California 94720). *Appl. Opt.;* **19**: No. 14, 2332-2340(15 Jul 1980).

The theoretical basis is developed for a technique to fabricate nonaxisymmetric mirrors. Stresses are applied to a mirror blank that would have the effect of elastically deforming a desired surface into a sphere. A sphere is then polished into the blank, and upon release of the applied stress, the sperical surface deforms into the desired one. The method can be applied iteratively, so arbitrary accuracy should be possible. Calculations of the stresses and deformations are carried out in detail for an off-axis section of a paraboloid. For a very general class of surfaces, it is sufficient to only impose appropriate stresses at the edge of the blank plus a uniform pressure on the back.

34387 **Coded aperture imaging: the modulation transfer function for uniformly redundant arrays.** Fenimore, E.E. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Opt.;* **19**: No. 14, 2465-2471(15 Jul 1980).

Coded aperture imaging uses many pinholes to increase the SNR for intrinsically weak sources when the radiation can be neither reflected nor refracted. Effectively, the signal is multiplexed onto an image and then decoded, often by a computer, to form a reconstructed image. We derive the modulation transfer function (MTF) of such a system employing uniformly redundant arrays (URA). We show that the MTF of a URA system is virtually the same as the MTF of an individual pinhole regardless of the shape or size of the pinhole. Thus, only the location of the pinholes is important for optimum multiplexing and decoding. The shape and size of the pinholes can then be selected based on other criteria. For example, one can generate self-supporting patterns, useful for energies typically encountered in the imaging of laser-driven compressions or in soft x-ray astronomy. Such patterns contain holes that are all the same size, easing the etching or plating fabrication efforts for the apertures. A new reconstruction method is introduced called δ decoding. It improves the resolution capabilities of a coded aperture system by mitigating a blur often introduced during the reconstruction step.

STATISTICAL PHYSICS AND THERMODYNAMICS

34388 (ORNL/CSD—62) **Computational experience with an explicit difference scheme for a one phase Stefan problem.** Eklund, N.; Solomon, A.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

The results of a computational scheme of Rose [a method for calculating solutions of parabolic equations with free boundary, Math. Comp., 14: 249-256(1960)] are compared with the known analytic solution of a single-phase Stefan problem with constant boundary temperature. Rose's scheme was implemented in FORTRAN on a DEC PDP-10. Computations were performed for Stefan numbers St = 0.01, 0.1, 1, 10, and 100. Three relative mesh sizes ($\gamma = DT/(DX)^2 = 1/2$, 1/6, and 1/25) were used. For each St, the relative mesh size had very little effect on accuracy. However, taking $\gamma = 1/25$ resulted in dramatically increased computing time. The relative errors of temperature were large near the phase change front. 11 figures, 5 tables.

34389 **Strong coupling expansion for classical statistical dynamics.** Bender, C.M.; Cooper, F.; Guralnik, G.; Rose, H.A.; Sharp, D.H. (Theoretical Division, Los Alamos Scientific Laboratory, Uni-

versity of California, Los Alamos, New Mexico). *J. Stat. Phys.;* **22**: No. 6, 647-660(Jun 1980).

We discuss the simple, randomly driven system $dx/dt = -\mu x - yx^3 + f(t)$, where f(t) is a Gaussian random function or stirring force with $<f(t)f(t')> = F\,\delta(t-t')$. We show how to obtain approximately the coefficients of the expansion of the equal-time Green's function as power series in (1/R)/sup n/, where R is the internal Reynolds number (Fγ)/sup 1/2//μ, by using a new expansion for the path integral representation of the generating functional for the correlation functions. Exploiting the fact that the action for the randomly driven system is related to that of a quantum mechanical anharmonic oscillator with Hamiltonian $p^2/2 + m^2x^2/2 + vx^4 + \lambda x^6/2$, we evaluate the path integral on a lattice by assuming that the λx^6 term dominates the action. This gives an expansion of the lattice theory Green's functions as power series in 1/(λa)/sup 1/3/, where a is the lattice spacing. Using Pade approximants to extrapolate to a=0, we obtain the desired large-Reynolds-number expansion of the two-point function.

ELECTRICITY AND MAGNETISM

34390 (SLAC-PUB—2547) **Electromagnetic fields in an axial symmetric waveguide with variable cross section.** Kheifets, S. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 6p. (PEP-NOTE—331). NTIS, PC A02/MF A01.

A new class of separable variables is found which allows one to find an approximate analytical solution of the Maxwell equations for axial symmetric waveguides with slow (but not necessarily small) varying boundary surfaces. An example of the solution is given. Possible applications and limitations of this approach are discussed.

34391 **Raman and fluorescent scattering by molecules embedded in dielectric spheroids.** Wang, D.; Kerker, M.; Chew, H.W. (Clarkson College of Technology, Potsdam, New York 13676). EE 77-5-02-4361. *Appl. Opt.;* **19**: No. 14, 2315-2328(15 Jul 1980).

Fluorescent and Raman scattering by molecules embedded in dielectric particles is strongly dependent on the morphology and optical properties of the particle, the distribution of active molecules within the particle, and, in the case of nonspherical particles, orientation. The model previously applied to spheres and cylinders is now extended to spheroids. The extended boundary condition method (EBCM) has been used to calculate the transmitted field at the incident frequency that stimulates the process. The equivalence principle underlying the EBCM has also been applied to calculate the fields at the shifted frequency. Numerical results are presented to illustrate some of the effects of refractive index, size, shape, and orientation of the particles for models representing two polarizabilities of active dipoles embedded inside the particles.

MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 34383

COMMUNICATION, EDUCATION, HISTORY, AND PHILOSOPHY

34392 (BNL—28145) **Critical review of a quantitative study of a specialty in high energy particle physics.** White, D.H.; Sullivan, D. (Brookhaven National Lab., Upton, NY (USA); Carleton Coll., Northfield, MN (USA). Dept. of Anthropology and Sociology). 1980. Contract AC02-76CH00016. 32p. (CONF-8006109—1). NTIS, PC A03/MF A01.

From International conference on the evaluation in science and technology theory and practice; Dubrovnik, Yugoslavia (30 Jun 1980).

A review is made of the authors' series of quantitative, historical, and social studies of the weak interactions of elementary particles. A short intellectual history, the quantitative methodology, and a summary of the papers analyzing specific episodes in this field are presented. The social organization of the field is described, and an overall policy for resource management is discussed. 6 figures, 3 tables.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 34405, 34430

34393 (ANL/FPP/TM—135) **GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array.** Boley, C.D. (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01.

A computer code for calculating the predictions of the Brambilla theory of lower-hybrid wave launching is documented.

34394 (DOE/ER—0070) **Report of the workshop on rf heating in mirror systems.** Price, R.E.; Woo, J.T. (eds.). (Department of Energy, Washington, DC (USA). Office of Fusion Energy; Rensselaer Polytechnic Inst., Troy, NY (USA)). Aug 1980. Contract AS02-77ET53053;W-7405-ENG-48. 77p. NTIS, PC A05/MF A01.

This report is prepared from the proceedings of the Workshop on RF Heating in Magnetic Mirror Systems held at DOE Headquarters in Washington, DC, on March 10-12, 1980. The workshop was organized into four consecutive half-day sessions of prepared talks and one half-day discussion. The first session on tandem mirror concepts and program plans served to identify the opportunities for the application of rf power and the specific approaches that are being pursued. A summary of the ideas presented in this session is given. The following sessions of the workshop were devoted to an exposition of current theoretical and experimental knowledge on the interaction of rf power with magnetically confined, dense, high temperature plasmas at frequencies near the electron cyclotron resonance, lower hybrid resonance and ion cyclotron resonance (including magnetosonic) ranges. The conclusions from these proceedings are presented.

34395 (PPPL—1692) **Methods of driving current by heating a toroidal plasma.** Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1980. Contract AM02-76CH03073. 9p. (CONF-800932—2). NTIS, PC A02/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

In addition to the usual mechanism which utilizes the Ohmic transformer current, which is necessarily pulsed, there exist several steady-state mechanisms. Heating mechanisms which can lend themselves efficiently to continuous current generation include neutral beams, Alfven waves, ion-cyclotron waves, lower-hybrid waves and electron-cyclotron waves.

34396 **Bifurcation of sharp boundary $\beta=1$ multipole equilibria.** Spencer, R.L. (Department of Physics, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Phys. Fluids;* **23**: No. 8, 1691-1697(Aug 1980).

The bifurcation of sharp boundary magnetohydrodynamic equilibria in linear multipoles of arbitrary order is studied using the hodograph method. In the low pressure limit, simple formulae are obtained for the shapes of multipole cusp equilibria. In the high pressure limit the equilibria are found to bifurcate; two different equilibria may exist for the same values of the external parameters. It is conjectured that a similar bifurcation will be encountered in the calculation of diffuse multipole equilibria at high beta.

PLASMA DIAGNOSTICS

34397 (DOE/ET/53004—1) **Ion beam probe diagnostic system. Technical progress report, 1 January 1979-30 June 1980. RPDL report No. 80-17.** Hickok, R.L.; Jennings, W.C.; Woo, J.T.; Connor, K.A. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1980. Contract AS02-76ET53004. 30p. NTIS, PC A03/MF A01.

Tokomak plasmas suitable for diagnostic development were produced during this period in RENTOR following technological improvements in the vacuum chamber and discharge cleaning systems. Secondary ion signals were obtained from the heavy ion beam probe on RENTOR leading to initial estimates of the plasma space potential, which appears to vary by several hundred volts during the plasma pulse. The principle of measuring space potential in a minimum-B geometry was established using an ion gun mounted at the center of the ALEX baseball coil. The neutral beam probe was installed for measuring the space potential using actual secondary ion signals from a hollow cathode arc in ALEX and preliminary tests have begun. The ion beam test stand was significantly altered to allow more flexibility in testing energy analyzers, ion guns, and ion focusing concepts.

34398 (PPPL—1688) **In-situ impurity measurements in PDX Edge plasma.** Staib, P.; Dylla, H.F.; Rossnagel, S.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1980. Contract AM02-76CH03073. 14p. (CONF-800455—18). NTIS, PC A02/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

The surface analysis station of PDX combines several surface analysis techniques (AES, XPS, SIMS) for in-situ measurement of impurity fluxes in the edge-plasma. The major impurities deposited on a sample surface during nondiverted PDX discharges are oxygen, titanium (limiter material) and chlorine. The impurity fluxes measured at different radial positions decreased by a factor of ten from

the plasma edge to the wall. The sample surface collecting the impurity ions is located behind a circular aperture. The observed broadening of the deposition profile of Ti relative to the aperture diameter enables an estimate to be made of the ratio of charge state/energy of Ti ions in the edge plasma. Time-resolved analyses of the deposited impurities are presented which indicate that the time behavior for various impurities may be quite different for different impurity species. This aspect is discussed in relation to probable impurity release mechanisms.

PLASMA KINETICS - EXPERIMENTAL

34399 (GA-A—15963) **Properties of diverted plasmas with magnetically expanded flux surfaces.** Ali Mahdavi, M.; Ohyabu, N.; Baker, D.R. (General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AT03-76ET51011. 13p. (IAEA-CN—38/PD; CONF-800707—18). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Vertical elongated 1.3:1 elliptical plasmas in which the outermost flux surfaces are magnetically expanded and diverted by external coils into the lower half of the Doublet III vacuum vessel are described. Approximately 5 cm of the nominal 45 cm plasma minor radius is diverted to the lower chamber. The diverted flux is expanded by more than a factor of ten before reaching the vessel wall. Photographic measurements show diffused hydrogen recycling light in the lower half of the vessel, with greatly reduced recycling at the normal limiters, and no evidence of localized particle flow to the vessel wall. A significant amount ($\sim$ 50%) of the ohmic power is radiated in the expanded boundary region. Comparison of similar low density plasmas ($\sim$ 2 x 10^{13} cm^{-3}) with and without the expanded boundary shows that (1) the expanded boundary reduces the influx of nickel and oxygen impurities by an order of magnitude, (2) the boundary also reduces the influx of injected argon and helium by a similar factor, and (3) the concentration of argon in a non-diverted plasma is reduced by a factor of 10 when the expanded boundary is turned on. The central radiated power falls by an order of magnitude, to less than 0.01 W/cm^3. Similarly, Z/sub eff/(0) drops from 3.2 to 2.1.

PLASMA KINETICS - THEORETICAL

34400 (COO—3077-164) **Alternating dimension plasma transport in three dimensions.** Grad, H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Dec 1979. Contract AC02-76ER03077. 27p. (CONF-791201—4). NTIS, PC A03/MF A01.

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

The alternating dimension (1 1/2 D) method of solving macroscopic adiabatic and transport problems is here generalized to arbitrary 3-D toroidal plasma confinement systems. The principal new result is the derivation of an evolution equation for the poloidal and toroidal fluxes in which second derivatives can be explicitly exhibited to show that the system is diffusive. This extends previous results in 2-D, axial symmetry and helical symmetry, where the flux functions for the magnetic field are explicit consequences of an ignorable coordinate, and the EBT closed magnetic line configuration. The eigenvalues (diffusion coefficients) are evaluated and are shown to represent one-dimensional relative diffusion among the adiabatic variables, independent of the representation (e.g. whether diffusion is measured relative to mass, or toroidal flux, or poloidal flux). The skin effect diffusion coefficient decouples from the other coefficients and represents diffusion of one magnetic field component relative to the other. Other transport coefficients such as those for mass and energy flow are intrinsically coupled. As in previously implemented alternating dimension codes, a 3-D code built to these specifications should be expected to be extremely accurate and efficient.

34401 (DOE/ET/53036—17) **Nonadiabatic effects of field ripple on energetic ions in tokamaks.** Hinton, F.L. (Texas Univ., Austin (USA). Fusion Research Center). Jun 1980. Contract AC05-76ET53036. 50p. (FRCR—212). NTIS, PC A03/MF A01.

Some effects of toroidal field ripple on energetic ion orbits in tokamaks are considered. A finite gyroradius generalization of the adiabatic orbit theory condition for ripple trapping is derived. Resonances between the cyclotron motion and the motion through the field ripple are discussed. Conditions on the magnitude of the field ripple and the gyroradius are derived, such that the phase space islands corresponding to the cyclotron resonances overlap the ripple-trapping region. The intrinsic orbit stochasticity resulting from island overlap may be described as pitch-angle scattering. The diffusion coefficient is obtained from a mapping which is derived from the equations of motion. After scattering into the ripple-trapping region of phase space, particles are lost due to guiding center drifts in the toroidal field. Applications to ions in reactor-size tokamaks are discussed.

34402 (LA-UR—80-2043) **Incomplete relaxation and finite beta plasmas.** Turner, L.; Christiansen, J.P. (Los Alamos Scientific Lab., NM (USA); UKAEA Culham Lab., Abingdon). 1980. Contract W-7405-ENG-36. 6p. (CONF-800484—6). NTIS, PC A02/MF A01.

From Reversed field pinch theory workshop; Los Alamos, NM, USA (28 Apr 1980).

The treatment of plasma relaxation presented in this paper is a natural generalization of the earlier treatment of Taylor and yields predictions of finite beta plasma confinement. The analysis yields predictions for global reversed-field pinch (RFP) parameters such as β/sub θ/, F, and θ. In qualitative accordance with the experimental evidence that RFP discharges have a cool outer region of high resistivity, we present a plasma model which permits vanishing wall values of pressure and current density.

34403 (ORNL/TM—7407) **Calculation of similarity solutions of partial differential equations.** Dresner, L. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

When a partial differential equation in two independent variables is invariant to a group G of stretching transformations, it has similarity solutions that can be found by solving an ordinary differential equation. Under broad conditions, this ordinary differential equation is also invariant to another stretching group G', related to G. The invariance of the ordinary differential equation to G' can be used to simplify its solution, particularly if it is of second order. Then a method of Lie's can be used to reduce it to a first-order equation, the study of which is greatly facilitated by analysis of its direction field. The method developed here is applied to three examples: Blasius's equation for boundary layer flow over a flat plate and two nonlinear diffusion equations, cc/sub t/ = c/sub zz/ and c/sub t/ = (cc/sub z/)/sub z/.

34404 **High-energy bremsstrahlung in an intense laser field.** Schlessinger, L.; Wright, J.A. (R and D Associates, P.O. Box 9695, Marina del Rey, California 90291). *Phys. Rev., A;* **22**: No. 3, 909-915(Sep 1980).

The cross section for bremsstrahlung emission and absorption by electrons in an intense laser field has been calculated in the Born approximation for the electron-ion potential. Typical numerical results are presented as a function of the ratio of the electron quiver energy to its energy and the ratio of the bremsstrahlung energy to the electron energy. The intense-field correction factor for the rate of bremsstrahlung emission and absorption for electrons with a Boltzmann distribution of energies has been calculated. Numerical results for the correction factor are presented for the Boltzmann case as a function of the ratio of the electron quiver energy to its thermal energy and the ratio of the bremsstrahlung energy to the thermal energy. For typical laser-fusion parameters, this correction factor which is the ratio of the thermal bremsstrahlung emission rate in the intense laser field to the rate at zero field can be quite significant. For a laser of wavelength 1.06 μm at an intensity of 3 x 10^{15} W/cm^2 and an electron temperature of 1 keV, the correction factor varies from 0.98 at a bremsstrahlung energy of 100 V to greater than 5 at a bremsstrahlung energy of 10 keV.

34405 **Alteration of Pfirsch—Schlueter transport in tokamaks by all four external sources.** Burrell, K.H. (General Atomic Company, San Diego, California 92138). DE-AT03-76ET51011. *Phys. Fluids;* **23**: No. 8, 1526-1531(Aug 1980).

Tokamak energy and particle transport are calculated for a plasma in the Pfirsch—Schlueter regime containing all possible external sources: particle, momentum, heat, and heat momentum. The effect of the last source has never been considered previously; its presence makes possible simultaneous control of the impurity flux into the plasma and of the heat flux from the plasma. Examples are given showing that such control is possible with existing neutral beam or rf sources.

34406 **Dielectric response in guiding center plasma.** Krommes, J.A.; Similon, P. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 8, 1553-1558(Aug 1980).

The dielectric function for a guiding center plasma is derived from the direct-interaction approximation. For the special case of thermal equilibrium, the result agrees with, although it is more detailed than, an earlier calculation of Taylor. An explicit formula for the collision operator Σ' is given. The calculation illustrates several important features of renormalized turbulence theory: (i) cancellation between the so-called diffusion and polarization parts of Σ' and (ii) the role of the renormalization in providing the proper description of adiabatic response.

34407 **Anomalous transport from plasma waves.** Manheimer, W.M. (Naval Research Lab., Washington, DC (USA)). *J. Phys. (Paris), Colloq.;* **2**: No. 7, C7.269-C7.278(1979).

From 14. International conference on phenomena in ionized gases (ICPIG-14); Grenoble, France (9 - 13 Jul 1979).

One of the principal manifestations of instability in plasma is the presence of anomalous transport. The problem then is how to describe and/or predict plasma behavior when the transport is dominated by unstable plasma waves. This paper describes a systematic approach to this problem and examines what knowledge of the instability is needed. Depending on the situation, the necessary information can be as little as the stability threshold, or as much as a full nonlinear description of the turbulent spectrum, with several intermediate possibilities. In all cases, this description of the instability is used to derive a set of anomalous transport coefficients for use in a fluid formulation. Description of the plasma then comes from a numerical solution of these fluid equations. Scaling laws can often be derived from these numerical solutions, however in general, scaling laws cannot be simply derived from first principles.

PLASMA INSTABILITIES

34408 (COO—2387-118) **Axisymmetric instability in a noncircular tokamak.** Lipschultz, B. (Wisconsin Univ., Madison (USA)). Oct 1979. Contract AS02-76ET53051. 114p. NTIS, PC A06/MF A01. Thesis.

The stability of dee, inverse-dee and square cross section plasmas to axisymmetric modes has been investigated experimentally in Tokapole II, a tokamak with a four-null poloidal divertor. Experimental results are closely compared with predictions of two numerical stability codes - the PEST code (ideal MHD, linear stability) adapted to tokapole geometry and a code which follows the nonlinear evolution of shapes similar to tokapole equilibria.

34409 **Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma.** Ono, M.; Porkolab, M.; Chang, R.P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08455). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 8, 1656-1674(Aug 1980).

Parametric decay processes near the ion cyclotron frequency are investigated experimentally and theoretically in multi-ion species plasmas. The relevant theoretical dispersion relation of the parametric coupling is derived, including the ion drift motion. Experimental data obtained in the Princeton L-4 device verify these theoretical predictions in some detail. In a helium-neon plasma, the relative ion drift motion excites electrostatic ion cyclotron waves (the kinetic ion-ion hybrid mode) when $\omega_0 > \Omega/\text{sub He/} + \Omega/\text{sub Ne/}$. In a region of large density gradient, the ion drift motion also excites low-frequency drift waves when $\omega_0 > \Omega/\text{sub He/} + \omega^*$. The experimental data are found to agree well with the theory. The relevance of these processes to ion cyclotron heating of fusion plasmas is discussed.

34410 **Parametric excitation of ion quasi-mode by the pump near the ion cyclotron frequency.** Ono, M.; Porkolab, M.; Chang, R.P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08455). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 8, 1675-1681(Aug 1980).

Parametric excitation of a nonresonant ion quasi-mode in a low density (i.e., $\omega/\text{sub p/i} \simeq \Omega/\text{sub i/}$) plasma is observed when the pump frequency is $\omega_0 >$ or $\simeq 2\Omega/\text{sub i/}$. From the interferometry measurement, the lower sideband is identified to be the cold lower hybrid wave and the low-frequency mode is shown to be a nonresonant ion quasi-mode. The dependence of the excitation process and the threshold upon density has been measured and was found to agree well with theory. The ion heating associated with this decay process is also observed. Such processes may take place near the plasma surface during ion cyclotron range of frequency heating experiments in tokamaks.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 34407, 34409

34411 **Observations of fluctuating $\omega/\text{sub p/}$ emission in Alcator tokamaks.** Hutchinson, I.H.; Kissel, S.E. (Plasma Fusion Center, Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-78ET51013.A002. *Phys. Fluids;* **23**: No. 8, 1698-1703(Aug 1980).

Measurements are presented of fluctuating millimeter-wave radiation from the Alcator tokamaks. Its characteristics are (1) rapid modulation, approaching 100% with rise time 3—4 μsec, (2) very narrow line width, <5 GHz at the plasma frequency, and (3) extremely large intensity, up to 200 times thermal. These characteristics distinguish this radiation from the steady $\omega/\text{sub p/e}$ emission previously documented and are interpreted as indicating nonlinear conversion of electrostatic oscillations as the origin of the radiation.

34412 **Current generation by unidirectional lower hybrid waves in the ACT-1 toroidal device.** Wong, K.; Horton, R.; Ono, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC0Z-76-CH03073. *Phys. Rev. Lett.;* **45**: No. 2, 117-120(14 Jul 1980).

An unambiguous experimental observation of current generation by unidirectional lower hybrid waves in a toroidal plasma is reported. Up to 10 A of current was driven by 500 W of rf power at 160 MHz.

FUSION POWER PLANT TECHNOLOGY

BLANKET ENGINEERING

34413 (ORNL/TM—7049) **Tokamak blanket design study, final report.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Aug 1980. Contract W-7405-ENG-26. 192p. NTIS, PC A09/MF A01.

A cylindrical module concept was developed, analyzed, and incorporated in a tokamak blanket system that includes piping systems, vacuum boundary sealing, and support structures. The design is based on the use of state-of-the-art structural materials (20% cold-worked type 316 stainless steel), lithium as the breeding material, and pressurized helium as the coolant. The module design consists of nested concentric cylinders (with an outer diameter of 10 cm) and features direct wall cooling by helium flowing between the outer (first-wall) cylinder and the inner (lithium-containing) cylinder. Each cylinder can withstand full coolant pressure, thus enhancing reliability. Results show that stainless steel is a viable material for a first wall subjected to a neutron wall loading of 4 MW/m^2 and a particle heat flux of 1 MW/m^2. Lifetime analysis shows that the first-wall design meets the goal of operating at 20-min cycles with 95% duty for 100,000 cycles. To reduce system complexity, a larger 20-cm-diam module also was analyzed for incorporation in the blanket assembly. Reliability assessment indicates that it may be possible to double the module in size from 10 to 20 cm in diameter. With a modest increase in coolant pumping power, a blanket assembly comprising 20-cm-diam modules can still achieve 100,000 operating cycles - equivalent to a 3.6-year design lifetime - with only one or two helium coolant leaks into the plasma.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 34401

34414 (LA-UR—80-2406) **Magnetic islands and stochastic field lines in the RFP.** Spencer, R.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800484—5). NTIS, PC A02/MF A01.

From Reversed field pinch theory workshop; Los Alamos, NM, USA (28 Apr 1980).

The effect of magnetic perturbations on RFP equilibria is considered. Using a Hamiltonian representation for the magnetic field lines, the formation of magnetic islands is discussed. The transition from magnetic island to stochastic field lines is also discussed. As an example, the effect of the magnetic perturbations caused by pumping ports in ZT-40 is computed using a crude model for the pumping port fields.

HEATING AND FUELING SYSTEMS

34415 (LA-UR—80-2500) **Stable heating and burn simulations of a reversed-field pinch reactor.** Moses, R.W. Jr.; Nebel, R.A.; Miley, G.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800948—1). NTIS, PC A02/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Grenoble, France (Sep 1980).

The reversed-field pinch provides three significant advantages as a fusion reactor: it can be ohmically heated, it operates at high β, and it is not restricted to a small aspect ratio. Experimentally, the best understood startup scenarios are self reversal, aided reversal and fast-field programming. On the basis of results from a one-dimensional transport and stability code, an ideal MHD stable startup and burn procedure is described in this paper. Pitch programming and a gas feed at the wall are used. This adiabatic startup is characterized by a high pitch near the minor axis and hollow current and pressure profiles. Ideally, it would be possible to have a reactor startup and burn without highly turbulent processes to deposit excessive amounts of energy on the wall. Potential problems of resistive instabilities and plasma-wall interactions are discussed.

34416 (LBL—11141) **Neutral beam development at the Lawrence Berkeley and Lawrence Livermore Laboratories.** Pyle, R.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 4p. (CONF-801011—2). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

The Lawrence Berkeley and Livermore Laboratories Neutral Beam Development Group's work proceeds along two lines. The first is required for the near-term applications (e.g., MFTF, TFTR,

and DIII), which require injection at energies up to 120 keV, ion currents per module up to 80 A, and pulse lengths ≧ 0.5 s. These systems are based on the acceleration and neutralization of positive ions. The second part of the program is devoted to development for longer-term applications: positive-ion-based systems with 150 to 200-keV/65 to 100-A/10 to 30-s modules and, smewhat later, negative-ion-based systems for injection at 200 keV and higher energies.

34417 (ORNL/TM—7422) **Results of hydrogen pellet injection into ISX-B.** Milora, S.L.; Foster, C.A.; Thomas, C.E. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 64p. NTIS, PC A04/MF A01.

High speed pellet fueling experiments have been performed on the ISX-B device in a new regime characterized by large-global density rise in both ohmic and neutral beam heated discharges. Hydrogen pellets of 1 mm in diameter were injected in the plasma midplane at velocities exceeding 1 km/s. In low temperature ohmic discharges, pellets penetrate beyond the magnetic axis, and in such cases a sharp decrease in ablation is observed as the pellet passes the plasma center. Density increases of ~ 300% have been observed without degrading plasma stability or confinement. Energy confinement time increases in agreement with the empirical scaling tau/sub E/ ~ n/sub e/ and central ion temperature increases as a result of improved ion-electron coupling. Laser-Thomson scattering and radiometer measurements indicate that the pellet interaction with the plasma is adiabatic. Penetration to r/a ~ 0.15 is optimal, in which case large amplitude sawtooth oscillations are observed and the density remains elevated. Gross plasma stability is dependent roughly on the amount of pellet penetration and can be correlated with the expected temporal evolution of the current density profile.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 34437

34418 (CONF-801011—1) **Safety and personnel access aspects of low activation fusion blankets.** Cheng, E.T.; Wong, C.P.C.; Maya, I.; Hopkins, G.R. (General Atomic Co., San Diego, CA (USA)). 1980. Contract AC07-76ID01570. 3p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

The use of silicon carbide and carbon materials for structural applications in fusion reactor first wall and blanket regions has been proposed and a continuing effort spent on the development of the ceramics technology. The advantages identified are an extremely low induced radioactivity inventory, a high temperature operating capability, abundant raw material resource availability, and minimized plasma impurity effects. One of the unique features of the applications of these materials to fusion reactor blanket designs is that no alloying element is needed in order to assure the specified mechanical properties such as occurs in metal alloys. The major source of long term radioactivity in these materials is impurities. The impurity elements and their concentrations carried over to the blanket structure during fabrication can be minimized by proper fabrication procedures and techniques. The safety and personnel access aspects of such fusion blankets in conjunction with the impurity element concentration are the main subjects of this paper.

34419 (DOE/ET/52022—5) **Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report.** Elleman, T. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). 1979. Contract AS05-76ET52022. 69p. NTIS, PC A04/MF A01.

Tritium diffusion measurements have been conducted in Al_2O_3, BeO, Y_2O_3, SiC, B_4C, Si_3N_4 and pyrolytic carbon as a basis for evaluating these materials as potential tritium barriers in fusion reactors. Deuterium solubility measurements were conducted with Al_2O_3, SiC and pyrolytic carbon to establish the pressure and temperature dependence of solubility and to identify solubility ranges. Hydrogen permeability measurements on commercially available Al_2O_3 and SiC materials were used as a check on calculated permeabilities and to provide data on hydrogen permeation rates in polycrystalline materials. The diffusion, solubility and permeation results are presented and discussed in terms of fusion reactor applications.

34420 (EGG—2018) **Fusion Reactor Safety Research Program annual report, FY-79.** Crocker, J.G.; Cohen, S. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1980. Contract AC07-76ID01570. 84p. NTIS, PC A05/MF A01.

The objective of the program is the development, coordination, and execution of activities related to magnetic fusion devices and reactors that will: (a) identify and evaluate potential hazards, (b) assess and disclose potential environmental impacts, and (c) develop design standards and criteria that eliminate, mitigate, or reduce those hazards and impacts. The program will provide a sound basis for licensing fusion reactors. Included in this report are portions of four reports from two outside contractors, discussions of the several areas in which EG and G Idaho is conducting research activities, a discussion of proposed program plan development, mention of special tasks, a review of fusion technology program coordination by EG and G with other laboratories, and a brief view of proposed FY-80 activities.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 34032

34421 (LA—8458-MS) **One-dimensional computer simulations of exploding pusher targets for the Los Alamos Helios laser system.** Gula, W.P. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

This report summarizes the results of a series of one-dimensional computer simulations done at Los Alamos for 10.6-μm laser pulses with peak powers in the 5 to 20 TW range on exploding pusher targets. These calculations were done in order to predict and understand the first experimental results on the Helios CO_2 eight-beam laser system.

34422 (LA—8469-MS) **Fuel temperature determination for ICF microspheres.** Henderson, D.B.; Giovanielli, D.V. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

The common heuristic expression for estimating thermonuclear burn in ICF microspheres far from bootstrap heating is often used for inversion to obtain peak temperatures from experimental data. It contains an ad hoc or fitted parameter and lacks some parameters of obvious influence in actual systems. We present an alternative expression, which may be usefully inverted and does not suffer these defects.

34423 (LA-UR—80-2499) **Inertial confinement fusion reactor systems.** Frank, T.G.; Bohachevsky, I.O.; Pendergrass, J.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 18p. (CONF-800950—1). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

A variety of reactor cavity concepts, drivers, and energy conversion mechanisms are being considered to realize commercial applications of ICF. Presented in this paper are: (1) a review of reactor concepts with estimates of practically achievable pulse repetition rates; (2) a survey of drivers with estimates of the requirements on reactor conditions imposed by beam propagation characteristics; and (3) an assessment of compatible driver-reactor combinations.

34424 (NRL-MR—4180) **Ion beam propagation in a filamented channel.** Ottinger, P.F.; Goldstein, S.A.; Mosher, D. (Naval Research Lab., Washington, DC (USA)). 3 Mar 1980. Contract AI01-77DP40042. 13p. NTIS, PC A02/MF A01.

The production of intense focused ion beams has led to the consideration of using z-discharge plasma channels to transport them several meters to inertial fusion targets. Analysis has shown that current bunching will occur in the channel during transport. In this report ion beam propagation in a filamented channel is investigated in order to determine the effects on radial beam containment in channels and on the radial beam density profile.

34425 **Progress of laser fusion at Lawrence Livermore Laboratory.** Ahlstrom, H.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *J. Phys. (Paris), Colloq.;* **2**: No. 7, C7.97-C7.111(1979).

From 14. International conference on phenomena in ionized gases (ICPIG-14); Grenoble, France (9 - 13 Jul 1979).

Inertial confinement fusion is the present and future source of energy in our universe. Derivatives, such as solar, geothermal, wind, and biomass are proposed as future substitutes for possible fuel sources. All of these possible sources of energy while they may be considered to be renewable do not fulfill the single most important criteria of being unlimited. Fuel reserves of more than 100 billion years are accepted as 'unlimited'. The understanding of fusion has many 'fathers', Bethe, Teller and many others, it has also has proponents (too many to list) as the world's energy supply. This author hopes that this Program's efforts will contribute positively to the advance to the time when fusion energy will positively contribute to the energy supply for mankind. Controlled fusion is judged by us to be the world's most challenging technological problem. The potential benefit to mankind of an unlimited source of energy and thus a higher standard of living make the acceptance of this challenge worth our while. There are many dedicated scientists working on controlled fusion to make this dream a reality. Magnetic and inertial fusion are in a horse race that must not be allowed to falter or to be cancelled. Fusion is the future of the world and one of these approaches to fusion is vital to our future generations.

34426 (SAND—80-1546) **Pulsed magnetic field distribution near conducting rings.** Patterson, E.L.; Freeman, J.R. (Sandia National

Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01.

Measurements and calculations of the magnetic field distribution in the vicinity of stainless steel rings immersed in a pulsed magnetic field are compared. The computer code TRIDIF is found to produce results in good agreement with the measurements. The perturbations in magnetic field due to the rings are found to be considerably less than one would expect from one-dimensional skin depth considerations.

34427 (UCRL—52868) **High-power pulsed lasers.** Holzrichter, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1980. Contract W-7405-ENG-48. 88p. NTIS, PC A05/MF A01.

The ideas that led to the successful construction and operation of large multibeam fusion lasers at the Lawrence Livermore Laboratory are reviewed. These lasers are based on the use of Nd:glass laser materials. However, most of the concepts are applicable to any laser being designed for fusion experimentation. This report is a summary of lectures given by the author at the 20th Scottish University Summer School in Physics, on Laser Plasma Interaction. This report includes basic concepts of the laser plasma system, a discussion of lasers that are useful for short-pulse, high-power operation, laser design constraints, optical diagnostics, and system organization.

34428 **Power-driven and adiabatic expansions into vacuum.** Farnsworth, A.V. Jr. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Fluids;* **23**: No. 8, 1496-1500(Aug 1980).

Analytical solutions are obtained for the planar, cylindrical, and spherical expansions into vacuum of matter initially concentrated at a plane, a line, or a point. Both power-driven and adiabatic expansions are considered, where in the power-driven case, the specific power is deposited uniformly in space, but may vary in time according to a power law. These problems are found to be self-similar. The non-self-similar motion of matter during the adiabatic expansion that follows a power pulse of finite duration has also been addressed and a solution has been obtained.

34429 **Theoretical multiple beam overlap from channel transport of intense particle beams.** Wright, T.P.; Halbleib, J.A. Sr. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Phys. Fluids;* **23**: No. 8, 1603-1611(Aug 1980).

The overlap of intense particle beams transported in current-carrying plasma channels for inertial confinement fusion has been studied. Basic geometric considerations suggest an upper bound on the current density gain of N/4 due to the overlap of N uniform beams that are transported to the overlap region in channels. For "hot" electron beams this limit is seldom approached. For "cold" ions beams with radial distributions peaked on channel axes, this limit can be attained and even exceeded. From the standpoint of channel energetics, it is desirable to minimize the transverse energy of the ions in the channel which is quantified by the average ion angle θ. In order to optimize the ion overlap it is necessary to satisfy $\theta < 2N/sup -1/2/$. A spherical multi-"disk" model of converging plasma channels is developed with the constraint that the geometrical overlap radius (where the incoming channels touch each other) remain as small as possible in order to avoid excessive beam expansion in the overlap region. Details of electron transport and escape are explained using adiabatic drift theory.

34430 **Relativistic-electron-beam/target interaction in plasma channels.** Halbleib, J.A. Sr.; Wright, T.P. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Phys. Fluids;* **23**: No. 8, 1612-1619(Aug 1980).

A model describing the transport of relativistic electron beams in plasma channels and their subsequent interaction with solid targets is developed and applied to single-beam and multiple-beam configurations. For single beams the targets consist of planar tantalum foils and, in some cases, cusp fields on the transmission side of the foils are employed to improve beam/target coupling efficiency. In the multi-beam configurations, several beams are arranged in wagon-wheel fashion so as to converge upon cylindrical targets, consisting of either hollow tantalum or solid graphite cylinders, located at the hub. For 0.3-cm beam radii that are less than or equal to the channel radii, mean specific power depositions up to about 17 TW/g per MA of injected beam current are obtained for single beams; 12-beam results are typically an order-of-magnitude less. The corresponding enhancements are up to five times the collisional stopping power for either single or multiple beams. Substantial improvement is predicted for the multi-beam interaction should future channel technology permit transport at higher current densities in smaller channels.

34431 **Model for laser driven ablative implosions.** Max, C.E.; McKee, C.F.; Mead, W.C. (Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Phys. Fluids;* **23**: No. 8, 1620-1645(Aug 1980).

A theoretical model is presented describing the spatial structure and scaling laws of laser driven ablative implosions. The effect of inhibited electron thermal transport is explicitly included. The theory is in excellent agreement with results from a computer hydrodynamics code, under conditions when heat flow is flux-limited at the critical surface and suprathermal electrons do not form a dominant energy transport mechanism.

34432 **Particle beam interactions with plasmas and their application to inertial fusion.** Clauser, M.J.; Burns, E.J.T.; Chang, J. (Sandia Labs., Albuquerque, NM (USA)). *J. Phys. (Paris), Colloq.;* **2**: No. 7, C7.81-C7.85(1979).

From 14. International conference on phenomena in ionized gases (ICPIG-14); Grenoble, France (9 - 13 Jul 1979).

Present day target designs indicate that particle beams with 1-10 MJ and 100-500 TW, focused to intensities around 100 TW/cm^2 will be required to ignite targets with gains of 10-100. Due to uncertainties about the symmetry and stability of the implosion, these requirements may change by as much as an order of magnitude as more is learned. The particle beams will interact with target plasmas which have temperatures of several hundred electron volts and densities up to solid density. Under these conditions the main energy-loss mechanism is collisional, however, in the case of electrons, the orbits can be substantially altered by electric and magnetic fields. Experiments with thin foils have measured energy deposition enhancement by a factor of 5-10 with foils mounted in the anode, and by a factor of 20 or more with foils mounted on a stalk extending into the diode.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 33890, 33893, 33894, 33896, 33898, 33900

34433 (COO—2387-117) **Divertor experiments in a toroidal plasma, with E x B drift due to an applied radial electric field.** Strait, E.J. (Wisconsin Univ., Madison (USA)). Sep 1979. Contract AS02-76ET53051. 243p. NTIS, PC A11/MF A01.

Thesis.

It is proposed that the E x B drift arising from an externally applied electric field could be used in a tokamak or other toroidal magnetic plasma confinement device to remove plasma and impurities from the region near the wall and reduce the amount of plasma striking the wall. This could either augment or replace a conventional magnetic field divertor. Among the possible advantages of this scheme are easy external control over the rate of removal of plasma, more rapid removal than the naturally occurring rate in a magnetic divertor, and simplification of construction if the magnetic divertor is eliminated. Results of several related experiments performed in the Wisconsin Levitated Octupole are presented.

34434 (DOE/ET/53051—5) **Poloidal divertor experiment with applied E vector x B vector/B^2 drift.** Strait, E.J. (Wisconsin Univ., Madison (USA)). May 1980. Contract AS02-76ET53051. 34p. NTIS, PC A03/MF A01.

It has been proposed that the E vector x B vector/B^2 drift arising from an externally applied electric field could be used in a tokamak or other toroidal device to remove plasma and impurities from the region near the wall and to reduce the amount of plasma striking the wall, either assisting or replacing a conventional magnetic field divertor. A poloidal magnetic divertor (without pumping chamber) was added to the Wisconsin Levitated Toroidal Octupole, and the octupole was operated with a tokamak-like magnetic field configuration ($q = 0.7$). A radial electric field was applied in the scrape-off zone, causing an E vector x B vector/B^2 drift with a large poloidal component. This reduced plasma flux reaching the wall of the toroid by up to a factor of 5 beyond the effect of the magnetic divertor, for divertor configurations with both high and low magnetic mirror ratios, in good agreement with a simple theoretical model. Plasma density and density scale length were also reduced in the scrape-off zone, in qualitative agreement with the model. This was not accompanied by any new instabilities in the scrape-off zone, nor by any appreciable degradation of confinement of the central plasma.

34435 (DOE/ET/53051—6) **Stability and heating of a poloidal divertor tokamak.** Biddle, A.P.; Dexter, R.N.; Holly, D.T.; Lipschultz, B.; Osborne, T.H.; Prager, S.C.; Shepard, D.A., Sprott, J.C.; Witherspoon, F.D. (Wisconsin Univ., Madison (USA)). Jun 1980. Contract AS02-76ET53051. 23p. (CONF-800707—19). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Five experimental studies - two stability and three heating investigations - have been carried out on Tokapole II, a Tokamak with a four node poloidal divertor. First, discharges have been attained with safety factor q as low as 0.6 over most of the column without degradation of confinement, and correlation of helical instability onset with current profile shape is being studied. Second, the

axisymmetric instability has been investigated in detail for various noncircular cross-sectional shapes, and results have been compared with a numerical stability code adapted to the Tokapole machine. Third, application of high power fast wave ion cyclotron resonance heating doubles the ion temperature and permits observation of heating as a function of harmonic number and spatial location of the resonance. Fourth, low power shear Alfven wave propagation is underway to test the applicability of this heating method to tokamaks. Fifth, preionization by electron cyclotron heating has been employed to reduce the startup loop voltage by ~ 60%.

34436 (HEDL-SA—2019-FP) **Fusion Materials Irradiation test facility initial target design.** Peterson, R.E.; Hassberger, J.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1979. Contract AC14-76FF02170. 32p. (CONF-800607—84). NTIS, PC A03/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Design specifications of the FMIT facility are given. Some target design requirements are also presented. (MOW)

34437 (UCRL—84456) **TSTA compound cryopump.** Batzer, T.H.; Patrick, R.E.; Call, W.R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 18 Aug 1980. Contract W-7405-ENG-48. 25p. (CONF-801037—2). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

The Tritium System Test Assembly (TSTA), at the Los Alamos Scientific Laboratory, is intended to demonstrate realistic fuel supply and cleanup scenarios for future fusion reactors. The vacuum pumps must be capable of handling large quantities of reactor exhaust gases consisting largely of mixtures of hydrogen and helium isotopes. Cryocondensing pumps will not pump helium at 4.2 K; while cryosorption pumps using molecular sieves or charcoal have good helium pumping speed, the adsorbent clogs with condensed hydrogen while pumping mixtures of both. A solution to this problem is a compound design whereby the first stage condenses the hydrogen and the second, or sorption, stage pumps the helium. The TSTA pump designed at Lawrence Livermore National Laboratory uses argon gas to cryotrap the helium in the helium-hydrogen mixture. The argon is sprayed directly onto the 4.2 K surface at a rate proportional to the helium flow rate, permitting continuous pumping of the helium-hydrogen mixtures in a single-stage pump. However, the possibility of differential desorption as a first stage in the TSTA gas separation cycle required the inclusion of a first-stage hydrogen isotope condenser. The design, performance, and operating characteristics are discussed.

GENERAL AND MISCELLANEOUS

34438 (BNL—50973) **Annual highlights of programs in energy science.** (Brookhaven National Lab., Upton, NY (USA)). Dec 1978. Contract EY-76-C-02-0016. 102p. NTIS, PC A06/MF A01.

Progress is reported by the divisions of chemical sciences, metallurgy and materials science, and process sciences. a separate abstract was prepared for each division. (DLC)

MANAGEMENT

34439 (DOE/PR—0041) **Business strategy groups lessons learned.** (Department of Energy, Washington, DC (USA). Office of Procurement and Contracts Management). Aug 1980. 19p. NTIS, PC A02/MF A01.

Since FY 1977, 29 business strategy group (BSG) sessions are known to have been conducted. Four were in nuclear, 3 in resource applications, 9 in fossil energy, 10 in solar/geothermal, 1 in conservation, and 2 in EIA (systems operations and support services and programming services). DOE management needs to re-emphasize with the program mamangement the importance for the use of BSGs in the mission needs and advanced procurement plan stages of major acquisition. BSG briefings and report findings are summarized.

34440 (PUB—367) **Affirmative Action Compliance Program for Fiscal Year 1980.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 883p. NTIS, PC A99/MF A01.

Eleven chapters are used to delineate Lawrence Berkeley Lab's compliance, namely: (1) a description of LBL's facility, history, staff, mission, etc; (2) Affirmative Action policy statement; (3) dissemination (internal and external) per the implementation regulations; (4) identification of Affirmative Action responsibilities; (5) personnel policies; (6) past goal-setting process and accomplishment; (7) work-force array, job groups, availability determinations, identification of underutilization, and goals and timetables; (8) identification of problem areas and action-oriented programs; (9) listing and brief description of specific LBL Affirmative Action programs; (10) compliance with sex-discrimination guidelines; and (11) compliance with guidelines on discrimination because of religion or national origin.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 33234, 34190

34441 (AD-A—077103) **Hogan's PIES example and Lemke's algorithm. Technical summary report.** Josephy, N.H. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jun 1979. Contract DAAG29-75-C-0024. 18p. NTIS, PC A02/MF A01.

Newton's method for generalized equations was applied to the economic equilibrium problem of the Project Independence Evaluation System (PIES) Energy Model. The resulting algorithm involves solving a sequence of linear complementarity problems. Lemke's complementary pivot algorithm is used for this purpose. In this paper, it is shown that the linear complementarity problems will be copositive plus when the negative of the elasticity matrix, -e, of the consumer's quantity vs. price relation has the following properties: (1) positive diagonals, (2) negative off-diagonals, and (3) strict diagonal dominance. These conditions are satisfied for Hogan's example. Thus, Lemke's algorithm will either converge to a solution or show that no solution exists. Under the conditions of Theorem 1 of Josephy, a solution to the linear complementarity problems will always exist. Hence, Lemke's algorithm can be used when the conditions of the Theorem 1 of Josephy are satisfied.

34442 (CONF-800820—6) **Remarks on the generalized Tukey's lambda family of distributions.** Lam, H.; Bowman, K.O.; Shenton, L.R. (Chinese Univ. of Hong Kong, Shatin; Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Georgia Univ., Athens (USA)). 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

The family of curves generated by the mapping of the uniform density $F^{-1}(\text{lambda}) = \alpha + \beta[\text{lambda}/\text{sup } \gamma\delta/ - (1-\text{lambda})/\text{sup } \gamma/]/\gamma$, $0 < \text{lambda} < 1$, is considered. Primary interest is the application of the above density to approximating theoretical distribution functions of test statistics such as S.D., skewness, and kurtosis under non-normality. Moments are straight forward to evaluate in terms of gamma functions, or polygamma functions in special cases. 1 figure, 8 tables. (RWR)

34443 (LA—8095) **SALE: a simplified ALE computer program for fluid flow at all speeds.** Amsden, A.A.; Ruppel, H.M.; Hirt, C.W. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 105p. NTIS, PC A06/MF A01.

A simplified numerical fluid-dynamics computing technique is presented for calculating two-dimensional fluid flows at all speeds. It combines an implicit treatment of the pressure equation similar to that in the Implicit Continuous-fluid Eulerian (ICE) technique with the grid rezoning philosophy of the Arbitrary Lagrangian-Eulerian (ALE) method. As a result, it can handle flow speeds from supersonic to the incompressible limit in a grid that may be moved with the fluid in typical Lagrangian fashion, or held fixed in an Eulerian manner, or moved in some arbitrary way to give a continuous rezoning capability. The report describes the combined (ICEd-ALE) technique in the framework of the SALE (Simplified ALE) computer program, for which a general flow diagram and complete FORTRAN listing are included. A set of sample problems show how to use or modify the basic code for a variety of applications. Numerical listings are provided for a sample problem run with the SALE program.

34444 (LA-UR—80-1185) **Performance evolution in a large scale system.** Brice, R.S.; Anderson, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 22p. (CONF-801004—1). NTIS, PC A02/MF A01.

From Computer performance evaluation users group conference; Orlando, FL, USA (Oct 1980).

This paper documents the evolution of system performance in an operating system from its initial use by a few friendly users in October 1978 to its present state. The system, DEMOS, was developed for the Cray Research Inc. (CRI) Cray-1 computer at the Los Alamos Scientific Laboratory (LASL) by staff members in the LASL Computer Science and Services Division. Some important features of DEMOS architecture are described. It is shown how the robustness in the design permitted major reduction in overhead to be achieved with only minor software changes. Particular emphasis is placed on file system design and performance because much of the system overhead reduction occurred as a result of changes to this system component. Also, some predictions are made regarding performance resulting from proposed modifications. 8 figures.

34445 (LA-UR—80-2342) **Block relaxation strategies.** Faber, V. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800699—2). NTIS, PC A02/MF A01.

From Elliptic problem solvers conference; Santa Fe, NM, USA (30 Jun 1980).

It is desired to solve the linear system Ax = b, where the matrix A is n x n block tridiagonal with block size m. This system is to be solved by block line relaxation when the largest block problem with block size m that can be cheaply solved directly is l x l. Iteration steps, strategies, and results are summarized. It is concluded that the convergence rate of some block relaxation strategies is much faster than that of the strategies generally used. (RWR)

34446 (LA-UR—80-2343) **Implementing techniques for elliptic problems on vector processors.** Buzbee, B.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 15p. (CONF-800699—3). NTIS, PC A02/MF A01.

From Elliptic problem solvers conference; Santa Fe, NM, USA (30 Jun 1980).

To provide the arithmetic power required by large-scale numerical simulations, the fastest computers today incorporate vector processing. Two types of vector architecture are defined, and the variation in performance that can occur on a vector processor as a function of algorithm and implementation, the consequences of this variation, and the performance of some basic operators on the two classes of vector architecture are discussed. The performance of some higher-level operators that should be used with caution is also considered. Then the implementation of techniques for elliptic problems using the operators discussed previously is reviewed. Included are Fast Poisson solvers, dissection, and point, line, block, and conjugant gradient schemes. Finally, some areas of research are noted. 1 figure. (RWR)

34447 (LBL—10189/1) **BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition.** Friedman, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

CONTROL DATA will be releasing their FORTRAN 77 compiler, FTN5, by September 1979. It is anticipated that FTN5 will be made available on the BKY 7600 system by mid-1980. This Bulletin is based on technical material prepared by CONTROL DATA detailing those FORTRAN language features that are changing as a result of the new FORTRAN-77 standard and their implementation of the FTN5 compiler. Suggestions to minimize conversion problems are offered here, as well as stragegies to make programs FTN4/FTN5 compatible. Actions taken by the FTN4 to FTN5 conversion program F45 are described in each instance.

34448 (SAND—80-1124) **User guide for transferring data from NOS (Network Operating System) to Applicon Graphics System.** Young, E.G.; Grube, L.K. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 10p. NTIS, PC A02/MF A01.

This document is a guide for obtaining data from Sandia Central Computing site that are to be introduced into a drawing file on Applicon Graphics Systems. 1 figure.

34449 (SAND—80-1146) **Multiple precision integer operation package.** Hanson, R.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01.

A package of FORTRAN codes has been developed for certain multiple precision integer operations. These operations include basic arithmetic, modular exponentiation, and conversion of numbers to and from decimal representation. Reliability of the results is maintained by cross-checking both the lengths of internal working storage arrays against the requirements of the operations, and the size and sign of the internal representation of the digits. 10 figures.

34450 (SLAC-TN—80-2) **SLAC/RAI LSI-11/2 construction/configuration guide.** Kieffer, J. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 65p. NTIS, PC A04/MF A01.

This document serves as a user's manual as well as a guide to building and testing an LSI-11/2 as packaged by SLAC Research Area Instrumentation. The manual is divided into the following chapters. Introduction to user-configured systems using the SLAC 135-637 chassis; Buying modules (PC boards) and subcomponents of the system; Details of the SLAC MK-II chassis (SLAC 135-637); Preliminary testing instructions; Installation of computer modules into finished chassis; System testing; Software notes. 23 figures. (RWR)

34451 (UCRL—15258) **Development and application of data flow computers. Final report, January 17, 1978-September 30, 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Jan 1980. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01.

The contributions of MIT in collaboration with the Lawrence Livermore Laboratory (LLL) in a joint study of concepts of data flow program structure, language design, and computer architecture as applied to highly parallel computation for problems of interest to LLL are described. The major achievements of the work during the period of the contract (January 1978 through September 1979) are the following: design of the programing language VAL; ttranslator/interpreter implementation of VAL; analysis of a simplified hydrodynamics code - simple; and negotiation of continuing support from the Department of Energy. These activities are reviewed very briefly. In addition, projects relating to various aspects of data flow computation have been carried out and documented, and the group has participated in a variety of activities of an educational or information exchange character. (RWR)

34452 (UCRL—84446) **Simulation study of the configuration dependent performance of a prioritized, CSMA broadcast network.** Watson, W.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 12 Jun 1980. Contract W-7405-ENG-48. 10p. (CONF-801017—1). NTIS, PC A02/MF A01.

From IEEE computer society meeting, LCN-V; Minneapolis, MN, USA (6 Oct 1980).

A high-speed (50 megabits per second), multinode (20 nodes), prioritized, CSMA broadcast network has been studied via a discrete event simulation. The results imply that, for those networks that employ some kind of random persistent CSMA versus CD prioritized-channel access, network performance is affected by perturbations in the network geometry; that is, the performance of a CSMA broadcast network can be degraded significantly when that network is extended to include remotely situated nodes. The results are obtained for and comparisons made of two radically different contention mechanisms, the mechanism employed in the Hyperchannel of NSC and an Ethernet-like scheme. 10 figures.

34453 **Construction of well-conditioned systems for Fredholm I problems by mesh adapting.** Hagin, F. (Department of Mathematics, University of Denver, Denver, Colorado 80208). EY-76-S-02-2482. *J. Comput. Phys.;* **36**: No. 2, 154-169(1 Jul 1980).

The paper addresses the numerical solution of linear Fredholm I integral equations of the type arising from various one-dimensional inverse scattering problems. Typically when these equations are discretized they lead to very ill-conditioned algebraic systems. It is shown that for these types of kernels a relatively simple mesh adapting scheme leads to very well-conditioned systems. Moreover, when the kernel is not known explicitly but must be generated by numerically solving a boundary-value problem, it is shown that an asymptotic analysis can extract the information necessary to successfully adapt this mesh.

34454 **Collocation approximation to eigenvalues of an ordinary differential equation: The principle of the thing.** de Boor, C.; Swartz, B. W-7405-ENG.36. *Math. Comput.;* **35**: No. 151, 679-694(Jul 1980).

It is shown that simple eigenvalues of an mth order ordinary differential equation are approximated within O(Δ/sup 2k/) by collocation at Gauss points with piecewise polynomial functions of degree <m+k on a mesh Δ. The same rate is achieved by certain averages in case the eigenvalue is not simple. The argument relies on an extension and simplification of Osborn's recent results concerning the approximation of eigenvalues of compact linear maps.

34455 **Compact, implicit difference schemes for a differential equation's side conditions.** Swartz, B. *Math. Comput.;* **35**: No. 151, 733-746(Jul 1980).

Lynch and Rice have recently derived compact, implicit (averaged-operator) difference schemes for the approximate solution of an mth order linear ordinary differential equation under m separated side conditions. We construct here a simpler form for a compact, implicit difference scheme which approximates a more general side condition. We relax the order of polynomial exactness required for such approximate side conditions. We prove appropriate convergence rates of the approximate solution (and its first m-1 divided differences) to (those of) the solution, even, of multi-interval differential equations. Appropriate, here, means kth order convergence for schemes whose interior equations are exact for polynomials of order k+m and whose approximation of a side condition of order l is exact for polynomials of order k+l. We also prove the feasibility of shooting (and of multiple shooting) based on initial divided differences. The simplicity of the proofs is based upon the simplicity of form of the approximating side conditions, together with the crucial stability result of Lynch and Rice for their interior difference equations under divided-difference initial data.

34456 **Single transmission line interrogated multiple channel data acquisition system.** Fasching, G.E.; Keech, T.W. Jr. (to Dept. of Energy). US Patent 4,196,417. 1 Apr 1980. Filed date 23 Nov 1977. 20p.

PAT-APPL-854,444.

A single transmission line interrogated multiple channel data acquisition system is provided in which a plurality of remote station/sensor circuits each monitors a specific process variable and each transmits measurement values over a single transmission line to a master interrogating station when addressed by said master interrogating station. Typically, as many as 330 remote stations may be parallel connected to the transmission line which may exceed 7000 feet. The interrogation rate is typically 330 stations/second. The master interrogating station samples each station according to a shared, charging transmit-receive cycle. All remote station address signals, all data signals from the remote stations/sensors and all power for all of the remote station/sensors are transmitted via a single continuous terminated coaxial cable. A means is provided for periodically and remotely calibrating all remote sensors for zero and span. A provision is available to remotely disconnect any selected sensor station from the main transmission line.

INFORMATION HANDLING

34457 (CONF-800820—5) **Integrated approach to data editing.** Liepins, G.E.; Pack, D.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

Localization of error in particular fields of categorical records from large data sets that fail to fall in a deterministically known constrained space is addressed. This paper reports a simulation study of a compromise in which the weights are related to the number of active failed edits and/or the number of active passed edits for a field. The paper also discusses MWFI formulation problems that must be dealt with to produce a fully integrated approach to data editing - one that will be applicable to continuous fields. 3 figures, 2 tables.

34458 (LBL—10437) **Computer-aided visualization of database structural relationships.** Cahn, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 10p. (CONF-801008—1). NTIS, PC A02/MF A01.

From 43. annual meeting of the American Society for Information Sciences; Anaheim, CA, USA (5 Oct 1980).

Interactive computer graphic displays can be extremely useful in augmenting understandability of data structures. In complexly interrelated domains such as bibliographic thesauri and energy information systems, node and link displays represent one such tool. This paper presents examples of data structure representations found useful in these domains and discusses some of their generalizable components. 2 figures.

34459 (LBL—10648) **Efficient access of compressed data.** Eggers, S.J.; Shoshani, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 22p. (CONF-801009—2). NTIS, PC A02/MF A01.

From 6. international conference on very large data bases; Montreal, Canada (1 Oct 1980).

A compression technique is presented that allows a high degree of compression but requires only logarithmic access time. The technique is a constant suppression scheme, and is most applicable to stable databases whose distribution of constants is fairly clustered. Furthermore, the repeated use of the technique permits the suppression of a multiple number of different constants. Of particular interest is the application of the constant suppression technique to databases the composite key of which is made up of an incomplete cross product of several attribute domains. The scheme for compressing the full cross product composite key is well known. This paper, however, also handles the general, incomplete case by applying the constant suppression technique in conjunction with a composite key suppression scheme.

34460 (SAND—80-1252C) **Implementation of logical networks in System 2000 data bases.** Hall, R.C. (Sandia Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 27p. (CONF-801007—1). NTIS, PC A03/MF A01.

From 1980 fall conference of the Association of System 2000 Users for Technical Exchange (ASTUTE); San Francisco, CA, USA (6 Oct 1980).

The need for a means to express general relationships (networks) among entity occurrences (data sets) in System 2000 data bases is established. Integer expression of general path segments is described as a means to meet this need. Operations on the expressions are also described. Two possible implementations are discussed. Either or both of these implementations can be included by the user in System 2000 data bases. They are compatible with the System 2000 hierarchical data model, and could also be internally implemented as an enhancement to System 2000. 4 figures.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Acurex Corp., Mountain View, CA (USA)
Environmental control technologies for a northern California coal-fired power plant, 5:33597 (P—300-80-002)
Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.
Further development of a low-cost solar panel. Final report, September 28, 1979-May 31, 1980, 5:33513 (ALO—2032-2)
Allied-General Nuclear Services, Barnwell, SC (USA)
Mixed oxide conversion facility alternative conceptual designs, 5:33306 (AGNS—35900-CONF-71)
Potential for meeting IAEA safeguards goals for reprocessing, 5:33341 (AGNS—35900-Conf-85)
American Planning Association, Chicago, IL
Protecting solar access: a guidebook for California communities, 5:33389 (P—500-80-013)
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
Ames Lab., IA (USA)
Adsorption of moisture by grain dust and control of dust hazards, 5:34124 (IS-M—285)
Assessment of needs for environmental controls for burning a coal-oil mixture in a slot forge furnace, 5:34123 (IS—4709)
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)
Crack depth determination by ultrasonic frequency analysis aided by dynamic photoelasticity, 5:34045 (IS-T—900)
Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
Efficient solar cells by space processing. Final report, October 1, 1978-December 14, 1979, 5:33404 (IS—4723)
Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)
FOUR: a general crystallographic Fourier program, 5:34369 (IS—4737)
High-temperature chlorination of coal fly ash, 5:33223 (IS-T—924)
Hodges residence: performance of a direct gain passive solar home in the 1979-1980 heating season, 5:33474 (IS-M—290)
Mechanistic study of the hydrogenolysis of neopentane on iridium, 5:33934 (IS-T—909)
Operational experiences from the federal solar heating and cooling demonstrations, 5:33473 (IS-M—286)
Power plant fly ash as a resource for alumina and cement, 5:33222 (IS-M—289)
Stress concentration factors due to flaws near the edge of a plate under tension, 5:33948 (IS-T—928)
Study of midwestern bituminous coal fly ash, 5:33215 (IS-T—923)
Surface self-diffusion of vanadium, 5:33867 (IS-T—925)
Applied Energy Systems, Inc., Cape Canaveral, FL (USA)
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
Applied Technology Corp., Norman, OK (USA)
Control and extinguishment of LPG fires. Final report, 5:33270 (DOE/EV/06020—T3)
ARCO Oil and Gas Co., Bakersfield, CA (USA)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Executive summary. Final report, 5:33496 (DOE/SF/10736—1/1)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Technical report. Final report, 5:33497 (DOE/SF/10736—1/2)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Appendices. Final report, 5:33498 (DOE/SF/10736—1/3)
Argonne National Lab., IL (USA)
Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
Carrier facilitated transport through membranes, 5:33926 (ANL—80-71)
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow, 5:33611 (DOE/ET/34209—T1)
Environmental assessment of a program to reduce oil and gas consumption by electric utilities, 5:33595 (ANL/EES-TM—97)
Environmental control technology survey of selected US strip mining sites. Volume 2B. Alabama. Water quality impacts and overburden chemistry of Alabama study site, 5:33224 (ANL/EMR—2(Vol.2B))
GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array, 5:34393 (ANL/FPP/TM—135)

Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)
Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles, 5:33802 (ANL/CNSV-TM—40)

Arizona Univ., Tucson (USA)
Slope parameter for the differential cross-section for the reaction p + d → X + d in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)

Arkansas Univ., Fayetteville (USA). Dept. of Agronomy
Adsorption and diffusion of plutonium in soil, 5:34152 (DOE/EV/04700—T1)

Army Armament Research and Development Command, Dover, NJ (USA). Large Caliber Weapon Systems Lab.
Optical extinction and N2 gas evolution on photodecomposition of Pb(N3)2. Final report, 1972-1975, 5:33935 (AD-A—077110)

Army Armament Research and Development Command, Dover, NJ (USA). Management Information Systems Directorate
The application of dc-dc energy conversion in a solar energy system. Final report, 5:33441 (AD-A—077112)

Atlantic Research Corp., Alexandria, VA (USA)
Chemistry of combustion of fuel-water mixtures. Final technical report, 5:33941 (AD-A—076958)

Atomic Industrial Forum, Inc., Washington, DC (USA)
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)

Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)

Avco-Everett Research Lab., Everett, MA (USA)
Investigation of the production of high density uniform plasmas. Volume I. Final report, 2 April 1978-2 April 1979, 5:34027 (AD-A—076492)

B

Barber-Nichols Engineering Co., Arvada, CO (USA)
Test results from the 500 kW direct contact pilot plant at East Mesa, 5:33569 (LBL—11107)

Battelle Columbus Labs., OH (USA)
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Determination of interaction between different waters and chemical antifreeze additives. Task 3 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33515 (DOE/CS/10510—T10)
Fuels from biomass systems for arid land environments, 5:33424 (DOE/TIC—11247)
Influence of coal mineral matter on slagging of utility boilers. Final report, 5:33587 (EPRI-CS—1418)
Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
Review of state-of-the-art of solar collector corrosion processes. Task 1 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33517 (DOE/CS/10510—T12)
Spent fuel resistance to internally produced cladding degradation, 5:33310 (HEDL-SA—2138)
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)

Battelle Pacific Northwest Labs., Richland, WA (USA)
Asphalt emulsion sealing of uranium mill tailings. 1979 annual report, 5:33317 (PNL—3290)
Assessment of the risk of transporting propane by truck and train, 5:34218 (PNL-SA—8202)
Chemistry of technetium in the environment, 5:33930 (PNL—2579)
Continuing study of mortality in Hanford workers, 5:34187 (PNL-SA—8106)
Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
Development of the high-temperature redox electrode. Interim report ending March 1980, 5:33564 (PNL—3377)
Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
Drift deposition from mechanical draft cooling towers, 5:33589 (PNL-SA—7422)
Estimating population health risk from low-level environmental radon, 5:34192 (PNL-SA—8291)
Experimental study of the response of the Galesville sandstone to simulated CAES conditions, 5:33635 (PNL—3399)
Gas and aerosol scavenging, 5:34130 (PNL-SA—8170)
Hybrid regional air pollution models, 5:34131 (PNL-SA—8431)
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
Measuring transient high temperature thermal phenomena in hostile environment, 5:33863 (PNL-SA—8295)
Mortality of Hanford radiation workers, 5:34188 (PNL-SA—8110)
Optimization of costs versus radiation exposures in decommissioning, 5:33627 (PNL-SA—8017)
Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
Separate effects test stand for obtaining hydrotransport data, 5:33233 (PNL—3468)
Turbulence spectrum observed by a fast-rotating wind-turbine blade, 5:33584 (PNL—3426)
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
Use of time averaged precipitation for wet removal in a regional air pollution assessment model, 5:34129 (PNL-SA—7658)

Bayer Chemical Co., Leverkusen (Germany, F.R.)
Efimov pathology in effective two-body system, 5:34307 (CONF-800829—5)
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
Few-body scattering integral equation approach, 5:34306 (CONF-800829—4)

Bechtel National, Inc., San Francisco, CA (USA)
Projected annual resource requirements at the national and regional level for the Department of Commerce energy forecast, 1985 and 2000, 5:33700 (PB—80-126956)

Bendix Corp., Kansas City, MO (USA)
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
Cure cycle evaluation for multilayer printed wiring boards, 5:34050 (BDX—613-2392)
Deburring: technical capabilities and cost-effective approaches, Lessons 3 and 4, 5:33945 (BDX—613-2373)
Deburring: technical capabilities and cost-effective approaches, Lessons 9 and 10, 5:33947 (BDX—613-2421)
Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
Inspection considerations for holes 0.040 inch and smaller, 5:33944 (BDX—613-2300)
Photoresist dip coating on thin film networks. Final report, 5:33901 (BDX—613-2398)
Plasma etchback of multilayer printed wiring boards, 5:34051 (BDX—613-2458)
Preliminary study of high-speed machining, 5:33946 (BDX—613-2401)
Semiconductor chip processing. Final report, 5:34052 (BDX—613-2466)
Uniform aluminum deposits on large nonplanar and planar polyimide substrates by physical vapor deposition, 5:33850 (BDX—613-2397)

Bendix Field Engineering Corp., Grand Junction, CO (USA)
Engineering report on the Great Divide Basin drilling project Sweetwater County, Wyoming, May 1980, 5:33301 (GJBX—124(80))

Bituminous Coal Research, Inc., Monroeville, PA (USA)
Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980, 5:33183 (DOE/ET/14815—12)
Test and evaluate the TRI-GAS Low-Btu Coal Gasification Process. Quarterly report, April-June 1980, 5:33182 (DOE/ET/10254—82)

Boeing Co., Seattle, WA (USA)
Solar project description for Design Construction Association single family dwelling, Big Fork, Montana, 5:33488 (SOLAR/1029—80/50)
Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland, 5:33486 (SOLAR/1012—80/50)
Solar project description for Moulder Corporation single family residence, Greenwood, Indiana, 5:33485 (SOLAR/1001—80/50)
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
Boeing Engineering and Construction Co., Seattle, WA (USA)
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))
Bradford National Corp., New York (USA)
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
Brookhaven National Lab., Upton, NY (USA)
1979 breeding bird censuses and summary of 1977-1979 results, 5:34142 (BNL—51161)
Acid precipitation and the aquatic environment, 5:34162 (BNL—28173)
Annual highlights of programs in energy science, 5:34438 (BNL—50973)
Atmospheric boundary layer measurements during summer MONEX 79 at Digha, India, 5:34110 (BNL—51149)
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
Collection, purification, and culture of cyanobacteria, 5:34156 (BNL—28136)
Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL), 5:33665 (BNL—51199)
Critical review of a quantitative study of a specialty in high energy particle physics, 5:34392 (BNL—28145)
Crop residues as a fuel for power generation, 5:33414 (BNL—50982)
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978, 5:33773 (BNL—51171)
Empirical model for controlling beam-beam effects in ISABELLE, 5:34070 (BNL—28033)
Energy-related perturbations of the northeast coastal zone: five years (1974-1979) of oceanographic research at Brookhaven National Laboratory, 5:34163 (BNL—51211)
Flash hydropyrolysis of coal. Quarterly report No. 10, July 1-September 30, 1979, 5:33210 (BNL—51172)
Health effects of photovoltaic technology, 5:33387 (BNL—51118)
ISABELLE vacuum systems, 5:34079 (BNL—27767)
Laser driven grating linac, 5:34071 (BNL—28131)
Macroeconomic effects of accelerated implementation of renewable energy technologies in the US, 5:33368 (BNL—51092)
Microdosimetric measurements for photons in a water phantom, 5:34367 (BNL—28157)
Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)
New ideas in calorimetry, 5:34093 (BNL—28132)
Picosecond electron transfer in diporphyrin models of Photosystem II of green plants, 5:34167 (BNL—28030)
Positive muon and the positron as probes of defects, 5:34249 (BNL—28196)
Ranking energy-conservation measures to establish research priorities: synopsis of a workshop, 5:33690 (BNL—51046)
Search for narrow states produced in the reaction $\pi^- p \rightarrow n + \gamma$'s at 13 GeV/c, 5:34284 (BNL—28057)
Search for narrow structures in the anti pp annihilation cross section from 1925 to 1955 MeV, 5:34270 (BNL—28142)
Single bunch fast longitudinal instability, 5:34068 (BNL—27971)
Sulfuric acid spills in marine accidents, 5:34161 (BNL—28123)
Tacoma mode, 5:34069 (BNL—27972)
Uranium scintillator calorimeter at the CERN ISR, 5:34080 (BNL—28214)
Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
Brown Univ., Providence, RI (USA)
Geothermal energy as a source of electricity. A worldwide survey of the design and operation of geothermal power plants, 5:33568 (DOE/RA/28320—1)
Budd Co., Fort Washington, PA (USA). Technical Center
Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)
Bundesamt fuer Gewerbliche Wirtschaft, Hamburg (Germany, F.R.)
Mineral oil statistics 1979 for the Federal Republic of Germany with comparative figures for January/December 1978, 5:33268 (NP—24979)
Bureau of Mines, Washington, DC (USA). Div. of Minerals Environmental Technology
Minerals environmental in-house and contract research and development in fiscal year 1980, 5:34147 (BM-IC—8827)
Burns and Roe Industrial Services Corp., Paramus, NJ (USA)
Direct application of east coast geothermal resources in a frozen food plant. Final report, 5:33578 (DOE/ET/27228—T1)
Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)

C

California Energy Commission, Sacramento (USA)
Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system, 5:33741 (P—500-80-019)
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
Environmental implications of electric-utility supply plans, 1978-2000, 5:33738 (P—300-80-005)
Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
Passive solar handbook, 5:33483 (NP—24992)
Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies, 5:33385 (NP—24996)
Proposed electric power projects, 5:33737 (P—300-80-001)
Regulations for the California Solar Energy Tax Credit, 5:33388 (P—500-79-016)
Solar energy economics for the county of Santa Barbara, 5:33510 (NP—25017)
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
California State Univ., Chico (USA)
User manual for geothermal energy assisted dairy complex computer programs: PREBLD, MODEL0, MODEL1, MODEL2, FRMAT2, PREPI2, NET2, DAIRY and DAIRY1, 5:33581 (DOE/ET/28434—T1)
California Univ., Berkeley (USA). Energy and Resources Group
Environmental aspects of renewable energy sources, 5:33680 (UCB/ERG—80-1)
California Univ., Berkeley (USA). Lawrence Berkeley Lab.
A15 multifilamentary superconductors by the infiltration process, 5:34380 (LBL—10761)
Advances in diagnostic instrumentation, 5:34177 (LBL—9892)
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
Air infiltration measurement techniques, 5:33780 (LBL—10705)
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)

BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition, 5:34447 (LBL—10189/1)
Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
Computer-aided visualization of database structural relationships, 5:34458 (LBL—10437)
Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2: BDL summary, Version 2.1, 5:33764 (LBL—8688(Rev.1))
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
Efficient access of compressed data, 5:34459 (LBL—10648)
First workshop on ultra-relativistic nuclear collisions, 5:34355 (LBL—8957)
Fluctuation analysis, 5:34381 (LBL—11055)
Formation and destruction of pollutants in combustion processes: clearing the air on the role of combustion research, 5:34125 (LBL—11237)
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory, 5:33673 (LBL—11349)
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
Neutral beam development at the Lawrence Berkeley and Lawrence Livermore Laboratories, 5:34416 (LBL—11141)
Normal emission photoelectron diffraction: a new technique for determining surface structure, 5:34099 (LBL—11017)
Operating instructions for LBL radon measurement facilities, 5:34137 (LBL—11097)
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
Physical aspects of the interface between the saturated and the unsaturated regimes, 5:34220 (LBL—11178)
Potential uses of spent shale in the treatment of oil shale retort waters, 5:33299 (LBL—11072)
Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979, 5:33666 (LBL—11183)
Random choice method for calculating fluid displacement in a porous medium, 5:33247 (LBL—11086)
Search for collective phenomena in relativistic nuclear collisions, 5:34360 (LBL—11123)
Sliding wear, toughness and microstructural relationships in high strength Fe/Cr/C experimental steels, 5:33854 (LBL—10994)
Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)

California Univ., Davis (USA). Dept. of Mathematics
Electrostatic fibrous air filters: a theoretical study. Final report, 5:34022 (UCRL—15137)

California Univ., Davis (USA). Dept. of Physics
Two-photon collisions and QCD, 5:34288 (SLAC-PUB—2503)

California Univ., Irvine (USA). Dept. of Radiological Sciences
Estimating the risk associated with computerized tomography doses, 5:34185 (CONF-791103—81)

California Univ., Livermore (USA). Lawrence Livermore Lab.
Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)
Climate effects workshop, 5:34134 (UCRL—84677)
Comparison assay of a gold plating solution by controlled-potential coulometry and fire assay, 5:33923 (UCID—18766)
Computer design of a high explosive velocity augmented kinetic energy penetrator, 5:33957 (UCRL—83559)
Design of a maze structure to attenuate blast waves, 5:34105 (UCRL—52921)
Development of the seismic input for use in the seismic safety margins research program, 5:33634 (UCRL—81944)
Dynamic behavior of LLNL buildings during aftershocks of the January 24, 1980 Greenville earthquake, 5:34222 (UCRL—52969)
Evaluation of oxidation techniques for preparing bioassay and environmental samples for liquid scintillation counting, 5:34153 (UCRL—52966)
Failure modes and durability of Kevlar/epoxy composites, 5:33909 (UCRL—83875)
Fusion microsphere targets, 5:33344 (UCRL—83399)
High-power pulsed lasers, 5:34427 (UCRL—52868)
Influence of propagation on off-resonant molecular excitation, 5:34365 (UCRL—84259(Rev.1))
LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980, 5:34221 (UCRL—52956)
Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
Long path optical extinction and meteorology in the San Francisco Bay Area, 5:34133 (UCRL—84339)
Minimally refined biomass fuels: an economic shortcut, 5:33432 (UCRL—84136)
Numerical analysis of laminar forced convection in a spherical annulus, 5:34034 (UCRL—84655)
Open-loop heliostat reflector, 5:33522 (UCID—18764)
Status report to DOE Nuclear Data Committee, 5:34309 (UCID—18577)
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Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
Public reaction to imposed risk, 5:33681 (UCRL—84839)
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
Simulation study of the configuration dependent performance of a prioritized, CSMA broadcast network, 5:34452 (UCRL—84446)
Status of LLNL granite projects, 5:33338 (UCRL—84613)
Technical evaluation of the proposed technical specification change for the North Anna Nuclear Power Station, Unit 1, 5:33626 (UCID—18672)
Temperature measurements of shocked energetic materials by time-resolved infrared radiometry, 5:34106 (UCRL—84587)
Tritium practices past and present, 5:34023 (UCRL—84318)
TSTA compound cryopump, 5:34437 (UCRL—84456)

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Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
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(Quark)onium theory and spectroscopy, 5:34289 (FERMILAB-CONF—80/63-THY)
Slope parameter for the differential cross-section for the reaction $p + d \rightarrow X + d$ in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)
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Properties of diverted plasmas with magnetically expanded flux surfaces, 5:34399 (GA-A—15963)
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Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects, 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume V. Review of secondary data, 5:33718 (P—300-80-012)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VI. Establishent characteristics, 5:33719 (P—300-80-013)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VII. Detailed survey, sampling methodology, 5:33720 (P—300-80-014)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VIII. Detailed establishment questionnaire, 5:33721 (P—300-80-015)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IX. Tabulated data collected (computer magnetic tape) , 5:33722 (P—300-80-016)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection , 5:33723 (P—300-80-017)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification , 5:33724 (P—300-80-018)
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National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))

I

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Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia, 5:33469 (DOE/NASA/CR—161507)
Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi, 5:33470 (DOE/NASA/CR—161509)
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Gamma scattering, 5:34087 (CONF-800747—3)
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
Removal of silica from Raft River geothermal water, 5:33570 (EGG-FM—5170)
Idaho Univ., Moscow (USA). Dept. of Physics
Natural convective heat transfer through an aperture in passive solar heated buildings, 5:33480 (LA-UR—80-2328)
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Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow, 5:33611 (DOE/ET/34209—T1)
Search for narrow states produced in the reaction $\pi^- p \rightarrow n + \gamma$'s at 13 GeV/c, 5:34284 (BNL—28057)

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Kinetics of excitons, biexcitons and free carriers in Si, 5:34373 (SAND—80-1697C)

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National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
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Anaerobic digestion of kelp, 5:33427 (NP—25045)
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Panel reports of the first session of the workshop on coal for California, 5:33241 (DOE/ET/12276—T1)
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Flywheel Seal Test Program, 5:33638 (SAND—80-7019)
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
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Metal-insulator-semiconductor photovoltaic devices, 5:33405 (PNL-SA—7778)

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Slope parameter for the differential cross-section for the reaction p + d → X + d in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)

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Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report, 5:33586 (AD-A—076975)
Living Systems, Winters, CA (USA)
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Los Alamos Scientific Lab., NM (USA)
Air quality regulation in spatial equilibrium models, 5:34141 (LA-UR—80-1753)
Application of MOOT to scattering of elastic waves from compound inclusions, 5:34046 (LA-UR—80-2039)
Attached sunspace heating performance estimates, 5:33477 (LA-UR—80-2236)
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
Block relaxation strategies, 5:34445 (LA-UR—80-2342)
Compilation of elemental concentration data for the United States geological survey's six geochemical exploration reference materials, 5:34229 (LA—8473-MS)
Conservation and solar: working together, 5:33481 (LA-UR—80-2330)
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
Development of an experimental test apparatus for natural convection solar collectors, 5:33519 (LA-UR—80-2329)
Differential cross sections for p + ^{3}He scattering from 19.5 to 47.5 MeV, 5:34313 (LA—8179-MS)
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2: BDL summary, Version 2.1, 5:33764 (LBL—8688(Rev.1))
DOE-2 sample run book. Version 2.1, 5:33763 (LBL—8678(Rev.1))
DYMAC digital electronic balance, 5:33342 (LA—8313-M)
Explosive generation of high magnetic fields in large volumes and solid state applications, 5:34370 (LA-UR—80-2182)
Finite element modeling of long-term fluid-structure interaction problems in geological media, 5:34225 (LA-UR—79-3016)
Fuel temperature determination for ICF microspheres, 5:34422 (LA—8469-MS)
Generalized ultrasonic system for microcomputer controlled data collection, 5:34047 (LA-UR—80-2040)
General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980, 5:33349 (LA—8454-PR)
Graphs of the cross sections in the Alternate Monte Carlo Cross Section library at the Los Alamos Scientific Laboratory, 5:34346 (LA—8394-MS)
Implementing techniques for elliptic problems on vector processors, 5:34446 (LA-UR—80-2343)
Incomplete relaxation and finite beta plasmas, 5:34402 (LA-UR—80-2043)
Inertial confinement fusion reactor systems, 5:34423 (LA-UR—80-2499)
Injection system for the Proton Storage Ring at LASL. Final report, 5:34078 (LA-UR—80-1945)
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
LASL high-current proton storage rings, 5:34086 (LA-UR—80-1946)
LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980, 5:34379 (LA—8446-PR)
LASL thermochemical hydrogen program status on September 30, 1980, 5:33355 (LA-UR—80-2400)
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
Magnetic islands and stochastic field lines in the RFP, 5:34414 (LA-UR—80-2406)
Matching bunched beams to alternating gradient focusing systems, 5:34073 (LA—8442-MS)
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{9}Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region, 5:34274 (LA-UR—80-1976)
Medium-energy physics program. Progress report, February 1-April 30, 1979, 5:34066 (LA—8257-PR)
Methane hydrate as an energy resource. A review with recommended future research, 5:33280 (LA—8368-MS)
Models for positive muon depolarization in spin glasses for zero external field, 5:34275 (LA-UR—80-2371)
Monochromatic neutral kaon beam, 5:34067 (LA—8444-MS)
Muon spin depolarization in nonmagnetic metals doped with paramagnetic impurities, 5:34253 (LA-UR—80-2375)
Muon spin rotation and other microscopic probes of spin-glass dynamics, 5:34371 (LA-UR—80-2372)
Natural convective heat transfer through an aperture in passive solar heated buildings, 5:33480 (LA-UR—80-2328)
NBS-LASL racetrack microtron, 5:34083 (LA-UR—80-1856)
^{56}Ni and the light curve of Type I supernova, 5:34233 (LA-UR—80-2197)
One-dimensional computer simulations of exploding pusher targets for the Los Alamos Helios laser system, 5:34421 (LA—8458-MS)
Operating experience and cesium recycling on the LASL polarized triton source, 5:34076 (LA-UR—80-1905)
Performance evolution in a large scale system, 5:34444 (LA-UR—80-1185)
Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)
Polarimeter for protons between 300 and 800 MeV, 5:34095 (LA-UR—80-1943)
Polarization transfer in inelastic scattering, 5:34319 (LA-UR—80-2427)
Polarized targets and polarized low energy neutrons at WNR, 5:34366 (LA-UR—80-1933)
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
Preliminary simulation studies of accelerator cavity loading, 5:34072 (LA—8405-MS)
Radio-frequency quadrupole: general properties and specific applications, 5:34074 (LA-UR—80-1855)
Reliability problems in power-generation systems, 5:33736 (LA-UR—80-2354)
Review of the experimental results on impurity centers in elemental semiconductors obtained by μSR and other techniques, 5:34255 (LA-UR—80-2377)
Rock bed behavior and reverse thermosiphon effects, 5:33545 (LA-UR—80-2429)
Role of valons in low-p/sub T/ physics, 5:34293 (LA-UR—80-2235)
SALE: a simplified ALE computer program for fluid flow at all speeds, 5:34443 (LA—8095)
Self-consistent theory of hadron-nucleus scattering. Application to pion physics, 5:34354 (LA-UR—80-2496)
Sensitivity of direct gain performance to detailed characteristics of the living space, 5:33478 (LA-UR—80-2266)

Stable heating and burn simulations of a reversed-field pinch reactor, 5:34415 (LA-UR—80-2500)
Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory, 5:33928 (LA-UR—80-2414)
Study of two passive solar systems containing phase change materials for thermal storage, 5:33475 (LA-UR—80-1669)
Temperature dependence of anomalous muonium hyperfine interactions in silicon, 5:34251 (LA-UR—80-2373)
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)

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Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)

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Uranium scintillator calorimeter at the CERN ISR, 5:34080 (BNL—28214)

M

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Handbook for photovoltaic cabling, 5:33444 (COO—4094-90)
Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system, 5:33636 (COO—4094-91)
Portable, X-Y translating, infrared microscope for remote inspection of photovoltaic solar arrays, 5:33402 (DOE/ET/20279—101)
Snow-covering effects on the power output of solar photovoltaic arrays, 5:33443 (COO—4094-61)
Solar photovoltaic systems for residences in the Northeast, 5:33445 (DOE/ET/20279—100)

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Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)

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DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
Temperature dependence of anomalous muonium hyperfine interactions in silicon, 5:34251 (LA-UR—80-2373)

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Organic recycling in agriculture, 5:33814 (NP—25012)

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Experimental studies in solid state and low temperature physics. Final report for 1966-1980, 5:34378 (DOE/ER/01569—147)

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Effects of spin-flip scattering on the dynamics of the superconducting order parameter, 5:34375 (DOE/ER/01569—149)
Electrical analog of a Josephson junction, 5:34377 (DOE/ER/01569—146)

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Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)

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Refinery siting workbook: appendices C to O, 5:33274 (DOE/RA/33001—01(Vol.2))

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Mound Facility explosives incinerator, 5:34102 (MLM—2762(OP))

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Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
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Radon monitoring program, February-April 1980, 5:34139 (MLM—2758)

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Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)

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Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)
Optimal thermionic energy conversion with established electrodes for high-temperature topping and process heating, 5:33747 (DOE/NASA/1062—6)

Preliminary results from a four-working space, double-acting piston, Stirling engine controls model, 5:33822 (DOE/NASA/1040—17)

National Bureau of Standards, Washington, DC (USA)
NBS-LASL racetrack microtron, 5:34083 (LA-UR—80-1856)

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Criteria for retrofit materials and products for weatherization of residences, 5:33781 (NBS-TN—982)
Experimental verification of a standard test procedure for solar collectors, 5:33520 (NBS-BSS—117)
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)

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Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)

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Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)

Oak Ridge National Lab., TN (USA)
Application of Modular Integrated Utility Systems (MIUS) concept as a strategy for urban rehabilitation and redevelopment, 5:33813 (ORNL/HUD/MIUS—53)
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
Biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978, 5:34158 (ORNL/TM—7127)
Calculation of similarity solutions of partial differential equations, 5:34403 (ORNL/TM—7407)
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
Cold slumping characteristics of a fluidized bed, 5:33239 (ORNL/TM—7377)
Computational experience with an explicit difference scheme for a one phase Stefan problem, 5:34388 (ORNL/CSD—62)
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
District-heating/cogeneration symposium, 5:33803 (CONF-790401—)
Efimov pathology in effective two-body system, 5:34307 (CONF-800829—5)
Energy in the '80s: decade of decision, 5:33667 (CONF-800212—)
Environmental and health aspects of biomass energy systems, 5:34116 (CONF-800814—11)
Estimating the risk associated with computerized tomography doses, 5:34185 (CONF-791103—81)
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)

Expression of embryonic hemoglobin genes in α-thalassemic and in β-duplication mice, 5:34228 (CONF-7905172—1)
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
Few-body scattering integral equation approach, 5:34306 (CONF-800829—4)
High voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, October 1, 1979-March 31, 1980, 5:34238 (ORNL/TM—7405)
Integrated approach to data editing, 5:34457 (CONF-800820—5)
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
Preparation of thorium-uranium gel spheres, 5:33307 (CONF-800802—12)
Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
Raman spectroscopy of molten mixtures of lithium and potassium sulfate, 5:33929 (CONF-800808—6)
Results of hydrogen pellet injection into ISX-B, 5:34417 (ORNL/TM—7422)
Scattering in the quasiperiodic and stochastic regimes, 5:34308 (CONF-800829—7)
Simulation approach to a regional resource environment conflict, 5:34166 (CONF-800819—2)
Soft x-ray transmission gratings, 5:34097 (CONF-800719—11)
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
Stochastic model of radioiodine transport, 5:34135 (CONF-8004111—1)
Stream sediment detailed geochemical survey for Date Creek Basin, Arizona, 5:33304 (GJBX—164(80))
Terrestrial perturbation experiments as an environmental assessment tool, 5:33679 (ORNL/TM—7186)
Three Mile Island: then and now, 5:33633 (DOE/TIC—11235)
Tracking of smokestack and cooling tower plumes using wind measurements at different levels, 5:34128 (ORNL/TM—7417)
Uncertainties in our understanding of energy conservation, 5:33774 (CONF-800835—2)
Use of a fiber-optics skin contamination monitor in the workplace, 5:33240 (CONF-800814—13)
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Development of bellows for sodium valve in Japan, 5:33625 (JAPFNR—507)
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Investigation on the reliability of expansion joint for piping with probabilistic method, 5:33624 (JAPFNR—506)
Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
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Methods of driving current by heating a toroidal plasma, 5:34395 (PPPL—1692)
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R

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Modification and implementation of the M.E.T.C. SIMPAC program, 5:33550 (DOE/AL/10563—T5)
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Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
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Rhode Island Univ., Kingston (USA). Dept. of Ocean Engineering
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
Rice Univ., Houston, TX (USA)
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
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Influence of propagation on off-resonant molecular excitation, 5:34365 (UCRL—84259(Rev.1))
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Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
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Fluidized bed incineration process design for transuranic waste, 5:33320 (RFP—2945)
US Department of Energy acceptance of commercial transuranic waste, 5:33328 (RFP—3110)
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Transmutation of radwaste using accelerators, 5:33321 (RHO-SA—174)

S

Sandia Labs., Albuquerque, NM (USA)
Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
Deflagration-to-detonation transition project: quarterly report for the period September through November 1979, 5:34103 (SAND—80-1157)
Delay modeling in logic simulation, 5:34058 (SAND—80-0420C)
Implementation of logical networks in System 2000 data bases, 5:34460 (SAND—80-1252C)
Microcomputer closed circuit television controller, 5:34056 (SAND—79-0688)
Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities, 5:33949 (SAND—80-0481)
User/programmer guide for UCMD100 set point manipulation from magnetic tape coordinate data, 5:33571 (SAND—80-1585)
VAWTDYN: a numerical package for the dynamic analysis of vertical axis wind turbines, 5:33585 (SAND—80-0085)
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Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology, 5:34048 (SAND—80-8733)
Sandia National Labs., Albuquerque, NM (USA)
Admittance of an infinitely long monopole antenna driven by a coaxial line, 5:34055 (SAND—78-1065)
Admittance of an infinitely long monopole antenna immersed in a dissipative medium and driven by a coaxial line with a nondissipative dielectric bead in the end, 5:34057 (SAND—79-1490)
Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste, 5:33334 (SAND—80-0312C)
Analysis of measurements based on singular value decomposition, 5:33953 (SAND—80-1482)
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
Basic data report for drillhole WIPP 30 (Waste Isolation Pilot Plant - WIPP), 5:33330 (SAND—79-0284)
Bibliography on shock-induced chemistry, 5:33931 (SAND—80-1642)
Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)
Design concepts to enhance nuclear power plant protection, 5:33612 (SAND—80-1428C)
Effects of insulation for the steam string of the TS-1S experiment, 5:33292 (SAND—80-0777)
Electronic structure of nonstoichiometric cubic hydrides, 5:34372 (SAND—79-1540C)
FY 80 heavy oil program. Second quarterly report, April 1980, 5:33248 (SAND—80-1019)
High temperature hybrids for use up to 275°C - drift and lifetime, 5:33565 (SAND—80-0444C)
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
Improved recursive formula for calculating shock response spectra, 5:33951 (SAND—80-1315C)
In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
Laboratory and field testing of improved geothermal rock bits, 5:33573 (SAND—80-7102)
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
Model capabilities for in-situ oil shale recovery, 5:33293 (SAND—80-1873C)
Multiple precision integer operation package, 5:34449 (SAND—80-1146)

Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)
Phoenix I energy extraction experiment, 5:34032 (SAND—80-0261)
Political side of risk: a new approach, 5:33675 (SAND—80-1871C)
Pulsed magnetic field distribution near conducting rings, 5:34426 (SAND—80-1546)
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
10^{13}/second 14 MeV neutron generator for cancer therapy, 5:34084 (SAND—80-1388C)
Swept narrow band random on random, 5:33954 (SAND—80-1534)
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
Transient response of a single-edge crack in an elastic half-plane, 5:33955 (SAND—80-1877C)
User guide for transferring data from NOS (Network Operating System) to Applicon Graphics System, 5:34448 (SAND—80-1124)

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Pico amp measurement circuit with high system isolation, 5:34100 (SAND—80-8222)
Scattering in the quasiperiodic and stochastic regimes, 5:34308 (CONF-800829—7)
Sensitivity experiments: a one-shot experimental design and the ASENT computer program, 5:34104 (SAND—80-8216)
Tritium practices past and present, 5:34023 (UCRL—84318)

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Future of photovoltaic energy conversion in developing countries, 5:33446 (SERI/TP—611-407)
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
Polymers in solar technologies: an R and D strategy, 5:33521 (SERI/TR—334-601)
Preliminary requirements for thermal storage subsystems in solar thermal applications, 5:33546 (SERI/RR—731-364)
SERAPH facility capabilities, 5:33504 (SERI/RR—632-702)
Social values and solar energy policy: the policy maker and the advocate, 5:33390 (SERI/RR—722-329R)
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Summary of the DPR, 5:33392 (SERI/TR—733-394)

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Solar index prediction methodology preliminary analysis, 5:33384 (DOE/ET/20090—4)

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Electromagnetic fields in an axial symmetric waveguide with variable cross section, 5:34390 (SLAC-PUB—2547)
Possibility of detecting triple gluon coupling and Adler-Bell-Jackiw anomaly in polarized deep inelastic scattering, 5:34294 (SLAC-PUB—2505)
PSI radiative decays, 5:34291 (SLAC-PUB—2510)
Radiative transitions from the psi (3095) to ordinary hadrons, 5:34276 (SLAC-PUB—2519)
Ratio of D^0 and D^+ lifetimes from their semileptonic decays, 5:34280 (SLAC-PUB—2532)
Recent experimental results on the beam-beam effects in storage rings and an attempt of their interpretation, 5:34075 (SLAC-PUB—2548)
RF Energy Compressor, 5:34059 (SLAC-PUB—2480)
SLAC linear collider, 5:34085 (SLAC-PUB—2526)
SLAC/RAI LSI-11/2 construction/configuration guide, 5:34450 (SLAC-TN—80-2)
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)

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Two-photon collisions and QCD, 5:34288 (SLAC-PUB—2503)

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Janata biogas plant, 5:33425 (NP—25010)

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T

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Energy substitution in rural domestic sector: use of cattle dung as a source of fuel, 5:33426 (NP—25011)
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)

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High temperature hybrids for use up to 275°C - drift and lifetime, 5:33565 (SAND—80-0444C)

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Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)

Tennessee Univ., Tullahoma (USA). Space Inst.
Evaluation of a Coriolis mass flow meter for pulverized coal flows, 5:33745 (DOE/ET/10815—T2)

Terra Tek, Inc., Salt Lake City, UT (USA)
Laboratory and field testing of improved geothermal rock bits, 5:33573 (SAND—80-7102)
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
Seal/lubricant systems for geothermal drilling equipment, 5:33572 (SAND—80-7101)
Texas A and M Univ., College Station (USA)
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{9}Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region, 5:34274 (LA-UR—80-1976)
Texas Univ., Austin (USA)
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{9}Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region, 5:34274 (LA-UR—80-1976)
Polarimeter for protons between 300 and 800 MeV, 5:34095 (LA-UR—80-1943)
Tertiary oil recovery processes. Annual report, October 1978-September 1979, 5:33243 (DOE/BC/20001—6)
Texas Univ., Austin (USA). Center for Energy Studies
Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
Texas Univ., Austin (USA). Center for Particle Theory
Progress report on research program in elementary particle theory, 1979-1980, 5:34300 (DOE/ER/03992—392)
Texas Univ., Austin (USA). Fusion Research Center
Nonadiabatic effects of field ripple on energetic ions in tokamaks, 5:34401 (DOE/ET/53036—17)
Thermo Electron Corp., Waltham, MA (USA)
Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
Total Environmental Action, Inc., Harrisville, NH (USA)
Passive solar design handbook. Volume one of two volumes. Passive solar design concepts, 5:33461 (DOE/CS—0127/1)
Toxicology Information Response Center, Oak Ridge, TN (USA)
Asbestos in air. A bibliography with abstracts, 1964-1980, 5:34126 (NLM/TIRC—80/2)
TPI, Inc., Beltsville, MD (USA)
Coordination/management tasks for the IEA and CCMS solar heating and cooling programs, 5:33462 (DOE/CS/30108—T2)
TRC Environmental Consultants, Wethersfield, CT (USA)
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
TRW Energy Systems Planning Div., Morgantown, WV (USA)
Rockwell Coal Lock Hopper Valve: METC SOA Test Valve No. A-16. State-of-the-art Lock Hopper Valve Testing and Development Project. Summary test report, 5:33184 (DOE/METC/SP—80/8)
TRW Environmental Engineering Div., Redondo Beach, CA (USA)
Phase change/heat storage materials data compilation. Final technical report, August 1978-January 1979, 5:33640 (AD-A—076414)
Tsukuba Univ., Sakura, Ibaraki (Japan)
Adsorption of moisture by grain dust and control of dust hazards, 5:34124 (IS-M—285)

U

Ueland and Junker, Architects and Planners, Philadelphia, PA (USA)
Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
UKAEA Culham Lab., Abingdon
General formulation of the isotherm migration method for reactor accident analysis, 5:33631 (CLM-P—582)
Incomplete relaxation and finite beta plasmas, 5:34402 (LA-UR—80-2043)
Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.
Gas flow in a centrifuge, 5:33347 (K/OA—4748)
Remarks on the generalized Tukey's lambda family of distributions, 5:34442 (CONF-800820—6)
United States Gypsum Co., Sweetwater, TX (USA)
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
University of Southern California, Los Angeles (USA)
Investigation of surface-stabilized high-pressure gas discharges. Final report, 22 May 1978-21 May 1979, 5:34029 (AD-A—077040)
Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics
Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
Geothermal exploration program, Hill Air Force Base, Davis and Weber Counties, Utah, 5:33555 (DOE/ET/28392—42)
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
Model study of the regional hydrogeologic regime, Roosevelt Hot Springs, Utah, 5:33552 (DOE/ET/28392—44)
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
Summary of potassium/argon age dating, 1979, 5:33551 (DOE/ET/28392—41)
Utah Univ., Salt Lake City (USA). Earth Science Lab.
Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide), 5:33562 (DOE/ID/12079—6)
Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide), 5:33561 (DOE/ID/12079—3)
Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1), 5:33563 (DOE/ID/12079—1)
Geothermal exploration program, Hill Air Force Base, Davis and Weber Counties, Utah, 5:33555 (DOE/ET/28392—42)

V

Vanderbilt Univ., Nashville, TN (USA). Medical Center
ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides, 5:34193 (DOE/EV/10343—6)
CAMIRD III: Computer Assisted Medical Internal Radiation Dosimetry. FORTRAN IV version, 5:34191 (DOE/EV/10303—5)
Quality control of software in dissimilar systems using a common clinical data base, 5:34173 (DOE/EV/10343—4)
Versar, Inc., Springfield, VA (USA)
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)
VSE Corp., Alexandria, VA (USA)
Report of ad hoc OTEC cold water pipe committee, 5:33458 (DOE/ET/21002—2)

W

Washington State Dept. of Natural Resources, Olympia (USA)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Washington Univ., Seattle (USA). Social Management of Technology Program
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)

Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.
Spent fuel handling and packaging program. Quarterly report, April-June 1980, 5:33309 (DOE/NV/10061—3)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.
Tokamak blanket design study, final report, 5:34413 (ORNL/TM—7049)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center
Air/gas system dynamics of fossil fuel power plants. Volume 2. Mathematical system analysis. Final report, 5:33590 (EPRI-CS—1444(Vol.2))
Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979, 5:33753 (DOE/ET/11300—T3)
Cell and stack design alternatives. Fourth quarterly report, May 1, 1979-July 29, 1979, 5:33749 (DOE/ET/11300—)
Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979, 5:33751 (DOE/ET/11300—T1)
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement, 5:33859 (DOE/ET/13513—T1)
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 6, November 15, 1979-February 15, 1980, 5:33860 (DOE/ET/13513—T2)
Westinghouse Hanford Co., Richland, WA (USA)
Spent fuel resistance to internally produced cladding degradation, 5:33310 (HEDL-SA—2138)
Westinghouse Research and Development Center, Pittsburgh, PA (USA)
Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979, 5:33750 (DOE/ET/11300—1)
Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979, 5:33752 (DOE/ET/11300—T2)
Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. First quarterly progress report, October 1-December 31, 1979, 5:33409 (SERI/PR—8119-2-T1)
Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. Second quarterly progress report, January 1-March 31, 1980, 5:33410 (SERI/PR—8119-2-T2)
Phase 2 of the array automated assembly task for the Low Cost Solar Array Project. Final report, October 1, 1978-October 30, 1979, 5:33403 (DOE/JPL/954873—8)
Superposition gas breakdown. Final report, 5:33601 (EPRI-EL—1484)
West Virginia Univ., Morgantown (USA). Coal Research Bureau
Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979, 5:33219 (DOE/ET/10533—9)
Wirtschaftsverband Erdoel- und Erdgasgewinnung e.V., Hannover (Germany, F.R.)
Annual report, 1979, 5:33707 (NP—25049)
Wisconsin Univ., Madison (USA)
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, April 1, 1980-June 30, 1980, 5:33608 (DOE/ET/29185—17)
Axisymmetric instability in a noncircular tokamak, 5:34408 (COO—2387-118)
Divertor experiments in a toroidal plasma, with E x B drift due to an applied radial electric field, 5:34433 (COO—2387-117)
Organization of the R chromosome region in maize, 5:34170 (COO—1300-45)
Poloidal divertor experiment with applied E vector x B vector/B^2 drift, 5:34434 (DOE/ET/53051—5)
Stability and heating of a poloidal divertor tokamak, 5:34435 (DOE/ET/53051—6)
Wisconsin Univ., Madison (USA). Mathematics Research Center
Hogan's PIES example and Lemke's algorithm. Technical summary report, 5:34441 (AD-A—077103)
Woods Hole Oceanographic Institution, MA (USA)
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)
Wyoming Univ., Laramie (USA)
Analysis of reverse combustion in tar sands: a one-dimensional model, 5:33290 (DOE/LETC—1761-2/1)

AUTHOR INDEX

Authors "surnames are indexed in the form appearing in the abstracted publication; given names are reduced to initials. Each author entry gives the publication title and the citation number. Report numbers, if applicable, are given in parentheses at the end of the entry. For publications with multiple authors, an author entry is provided for each. Entries for the second and succeeding authors give references to the first author.

Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

A

Abbott, D.T., Improved methods for measuring radioactive tracer accumulation and excretion by microarthropods, with applications for a mite species, Tyrophagus longior (Acarina, Acaridae), 5:34171 (DOE/EV/00641—38)

Abdel-Baset, M.B., Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202

Abraham, B.M., Wide range high sensitivity film balance, 5:34101

Acken, J.M., Delay modeling in logic simulation, 5:34058 (SAND—80-0420C)

Adams, G.B., Electrically rechargeable battery, 5:33643

Adams, P.H., Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities, 5:33949 (SAND—80-0481)

Adde, R., Mixing with Josephson junctions in the far infrared, 5:33987

Addison, G.E., Combination process for selected aromatic hydrocarbon production, 5:33263

Adelman, D.J., High-temperature chlorination of coal fly ash, 5:33223 (IS-T—924)

AdT. R.R. Jr., Characterization of alcohol/gasoline blends as a stratified-charge engine fuel: performance and emissions, 5:33848 (CONF-790520—, pp III.55.1-III.55.10)

Affolter, E., Second international conference on infrared physics, 5:34031 (CONF-790355—)

Agarwal, S.C., Microstructure of single and dual-ion irradiated Fe-20Ni-15Cr and Ti-6Al-4V alloys, 5:33890

Agnew, H.M., Nuclear power: in perspective, 5:33689 (CONF-800212—, pp 73-82)

Aguilera, E., *See* Ortiz, M.E., 5:34322

Aguilera-Navarro, V.C., Generalized Fermi sea for plane-wave Hartree-Fock theory. II. Semirealistic interactions in three dimensions, 5:34350

Ahlstrom, H.G., Progress of laser fusion at Lawrence Livermore Laboratory, 5:34425

Ahmad, I., Low-spin states of ^{250}Cf populated in the electron capture decay of 2.22-h ^{250}Es, 5:34345

Aitkenhead, W., Determination of the pion and kaon structure functions, 5:34296

Aizer, G., *See* Halderson, D., 5:34324

Akimov, Yu. K., Slope parameter for the differential cross-section for the reaction $p + d \rightarrow X + d$ in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)

Akins, J.H., Pico amp measurement circuit with high system isolation, 5:34100 (SAND—80-8222)

Albert, R.E., Carcinogens, 5:34212 (BNL—51118, pp 218-225)

Albright, N., Random choice method for calculating fluid displacement in a porous medium, 5:33247 (LBL—11086)

Albrow, M.G., High p/sub T/ transverse momentum physics at the CERN ISR, 5:34283 (LBL—8957, pp 281-325)

Alexander, C.W., *See* Carter, W.L., 5:33314

Alexander, J.M., *See* Logan, D., 5:34336

Alger, T.W., Polydisperse-particle-size-distribution function determined from intensity profile on angularly scattered light: author's reply to comment, 5:34385

Ali Mahdavi, M., Properties of diverted plasmas with magnetically expanded flux surfaces, 5:34399 (GA-A—15963)

Allen, C., *See* O'Keefe, D., 5:33354

Allen, C.H., Separate effects test stand for obtaining hydrotransport data, 5:33233 (PNL—3468)

Allen, T.W., *See* McDonald, R.J., 5:33773

Allred, D.D., *See* Booth, D.C., 5:33534
See Carver, G.E., 5:33533

Allsup, J.R., Ethanol/gasoline blends as automotive fuels, 5:33840 (CONF-790520—, pp I.7.1-I.7.13)

Alt, R.D., Battery clamping and retention, 5:33836

Alterman, J., *See* Dunkerley, J., 5:33742

Alvarez, O.E., Battery cell soldering apparatus, 5:33647

Amacher, M.C., Redox reactions involving chromium, plutonium, and manganese in soils, 5:34150 (DOE/DP/04515—1)

Ames, E.S., *See* Cook, C.W., 5:33331

Ammerlaan, A.C.F., Direct application of east coast geothermal resources in a frozen food plant. Final report, 5:33578 (DOE/ET/27228—T1)

Amr, A., Analysis of reverse combustion in tar sands: a one-dimensional model, 5:33290 (DOE/LETC—1761-2/1)

Amsden, A.A., SALE: a simplified ALE computer program for fluid flow at all speeds, 5:34443 (LA—8095)

Andersen, O., *See* Deleplanque, M.A., 5:34340

Anderson, C., *See* Albright, N., 5:33247

Anderson, C.A., Finite element modeling of long-term fluid-structure interaction problems in geological media, 5:34225 (LA-UR—79-3016)

Anderson, D.A., *See* Oguz, S., 5:33920

Anderson, D.L., *See* Johnson, A.J., 5:33320

Anderson, D.N., *See* T'ien, J.S., 5:33839

Anderson, D.R., Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)

Anderson, J., *See* Smith, R.J., 5:33879

Anderson, J.T., Development of a London moment readout for a superconducting gyroscope, 5:33976
See Cabrera, B., 5:33977

Anderson, J.W., *See* Brice, R.S., 5:34444

Anderson, L.L., *See* Chung, K.E., 5:33217

Anderson, R.H., *See* Vanderwerf, D.F., 5:33529

Anderson, T.D., Value of energy storage for direct-replacement solar thermal power plants, 5:33451 (DOE/JPL—1060-12(Vol.2), pp 169-197)

Andrade, E., *See* Ortiz, M.E., 5:34322

Andrews, J.E. Jr., Surface treatment of lead glass microsphere, 5:33343 (UCRL—83398)

Andrews, N.J., *See* Pratt, D.C., 5:33433, 5:33434

Andrews, R.A., Marketing fuel wood in New Hampshire, 5:33439
See Dammann, J.C., 5:33436

Antos, G.J., *See* Flagg, J.F., 5:33258

Antrim, W.D. Jr., Flat plate multiple pass solar collector using aqueous optical properties, 5:33530
Parabolic solar reflector for accurate and economic producibility, 5:33531

Appeldorn, R.H., *See* Vanderwerf, D.F., 5:33529

Arakawa, E.T., Soft x-ray transmission gratings, 5:34097 (CONF-800719—11)

Arand, J.K., *See* Guth, E.D., 5:33356

Arbuthnot, D.A., *See* Easter, R.C., 5:34121

Arieli, A., Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865

Arndt, J.M., *See* Thomson, W.J., 5:33181

Arnett, P.C., *See* Herrell, D.J., 5:34017

Arnold, G.B., *See* Wolf, E.L., 5:33872

Arrington, C.H. III, *See* Feldman, C., 5:33411

Asbury, J.G., New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)

Ashare, E., Feasibility study for anaerobic digestion of agricultural crop residues.

Dynatech report No. 1935, 5:33431 (SERI/TR—8157-1-T1)
Ashkin, M., *See* Daniel, M.R., 5:33983
Ashworth, J.H., Developing common information elements for renewable energy systems: summary and proceedings of the SERI/AID workshop, 5:33744 (SERI/TP—744-661)
Askew, W.S., Alternative transportation fuels, 5:33849 (CONF-800419—5)
Aspen, F.E., Effects of spin-flip scattering on the dynamics of the superconducting order parameter, 5:34375 (DOE/ER/01569—149)
Atwood, J.W., Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1), 5:33563 (DOE/ID/12079—1)
Ault, R.L., *See* Adams, P.H., 5:33949
Ayrault, G., *See* Agarwal, S.C., 5:33890
Azimov, S.A., Critical analysis of models for high-energy hadron-nucleus interactions, 5:34363 (LBL—8957, pp 465-532)

B

Baba, K., *See* Nefkens, B.M.K., 5:34315
Babelay, E.F. Jr., *See* Steele, R.S. Jr., 5:33639
Babij, E., *See* Pocalujka, L.P., 5:33339
Bach, W.D. Jr., Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
Bacher, A.D., Analysis of $^3He + {}^4He$ elastic scattering between 18 and 70 MeV with the resonating group method of Brown and Tang, 5:34316
Bacigalupi, C.M., Design of a maze structure to attenuate blast waves, 5:34105 (UCRL—52921)
Back, K.C., Toxicology of boranes and dichloromethane, 5:34207 (BNL—51118, pp 163-173)
Bacon, F.M., *See* Walko, R.J., 5:34084
Bahadur, S., Janata biogas plant, 5:33425 (NP—25010)
Bak, P., *See* Hastings, J.M., 5:33873
Baker, A.G., Gamma scattering, 5:34087 (CONF-800747—3)
Baker, D.E., *See* Amacher, M.C., 5:34150
Baker, D.R., *See* Ali Mahdavi, M., 5:34399
Baker, G.R., Vortex simulations of the Rayleigh—Taylor instability, 5:34265
Baker, J.G., *See* Gaston, R.J., 5:33232
Balcomb, J.D., Conservation and solar: working together, 5:33481 (LA-UR—80-2330)
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
Bale, E., *See* Ramsbottom, E., 5:33655
Ballantyne, J.M., Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
Balluffi, R.W., *See* Bristowe, P.D., 5:33855
Balma, M., *See* Martin, P., 5:33583
Bambas, K.J., Potential for meeting IAEA safeguards goals for reprocessing, 5:33341 (AGNS—35900-Conf-85)
Banks, D.O., Electrostatic fibrous air filters: a theoretical study. Final report, 5:34022 (UCRL—15137)
Bard, C.S., *See* Butz, T.R., 5:33304
Barger, V., $\tau\mu\nu$ decay signature for detecting F^{+-} and B^{+-} mesons in e^+e^- collisions, 5:34292
Barkhordar, P.M., *See* Jones, J.L., 5:33362
Barner, G.E., *See* Hughs, R.W., 5:33901
Barnes, M.H., Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—, pp 245-254)
Barnhart, B.J., Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
Barone, A., Light-sensitive Josephson junctions: ten years ago, ten years from now, 5:34000
Barr, D.W., Millimeter wave response of Nb variable thickness bridges, 5:34001
See Galfo, C.H., 5:34002
Barr, R., Report of ad hoc OTEC cold water pipe committee, 5:33458 (DOE/ET/21002—2)
Barraclough, B.L., Methane hydrate as an energy resource. A review with recommended future research, 5:33280 (LA—8368-MS)
Barron, W., Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
Barschall, *See* Haight, R.C., 5:34335
Bartenev, V.D., *See* Akimov, Yu. K., 5:34273
Bartholomew, C.H., *See* Moeller, A.D., 5:33190
Barton, C.J., *See* Mosier, J.E., 5:33326
Barton, D.S., *See* Aitkenhead, W., 5:34296
Bates, J.B., Raman scattering from NH_4^+ and ND_4^+ in beta-alumina, 5:34245
Batey, J.E., *See* McDonald, R.J., 5:33773
Batzer, T.H., TSTA compound cryopump, 5:34437 (UCRL—84456)
Baucum, W.E., Evaluation of a Coriolis mass flow meter for pulverized coal flows, 5:33745 (DOE/ET/10815—T2)
Bauer, E.K., International energy indicators, 5:33663 (DOE/IA—0010/2)
Bauer, T.S., *See* Nefkens, B.M.K., 5:34315
Baughman, M.L., Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
Baulov, V.I., *See* Lidorenko, N.S., 5:33826
Baum, J.W., *See* Varma, M.N., 5:34367
Baumel, C.P., Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
Baviere, M., *See* Bourrel, M., 5:33243
Beasley, M.R., Improved materials for superconducting electronics, 5:34007
See Wolf, E.L., 5:33872
Beausejour, Y., Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
Beavers, J.A., Determination of interaction between different waters and chemical antifreeze additives. Task 3 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33515 (DOE/CS/10510—T10)
See Diegle, R.B., 5:33516
Bechtold, R., Driving cycle comparisons of energy economies and emissions from an alcohol and gasoline fueled vehicle, 5:33844 (CONF-790520—, pp III.48.1-III.48.13)
Bechtold, R.L., *See* Samaga, B.S., 5:33843
Bedard, F.D., *See* Welker, N.K., 5:34013
Begum, R.J., *See* Hastings, J.M., 5:33873
Begun, G.M., *See* Smith, D.H., 5:33929
Bekefi, G., Relativistic electron beam crossed-field device, 5:34242
Belehrad, R., *See* Aguilera-Navarro, V.C., 5:34350
Bell, B.A., *See* Johnson, A.J., 5:33320
Bellina, C.R., CAMIRD III: Computer Assisted Medical Internal Radiation Dosimetry. FORTRAN IV version, 5:34191 (DOE/EV/10303—5)
Bender, C.M., Strong coupling expansion for classical statistical dynamics, 5:34389
Benenson, D.M., Fundamental investigation of arc interruption in gas flows. Final report, 5:33600 (EPRI-EL—1455)
Bennett, D.W., *See* Carlson, M.C.J., 5:33619
Bennett, W.S., *See* Taboas, A.L., 5:33328
Benshan, W., Characteristics of evolution of petroleum in Huanghua Depression, 5:33242 (JPRS—75887)
Benson, L.V., Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)
Berger, M.H., Gas flow in a centrifuge, 5:33347 (K/OA—4748)
Bergvall, J.A., Wood waste for energy study: executive summary, 5:33365 (NP—25083)
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Berk, J.V., Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
Berman, B.L., *See* Phyllips, T.W., 5:34314
Bernard, M.J. III, Environmental planning and assessment for highway vehicle use of alcohol fuels, 5:34111 (CONF-790520—, pp III.69.1-III.69.11)
Bernow, S.S., Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
Bernreuter, D.L., Development of the seismic input for use in the seismic safety margins research program, 5:33634 (UCRL—81944)
Berthelet, C., Magnesium aluminate spinel precipitation in MgO, 5:33903
Besenbruch, G., *See* O'Keefe, D., 5:33354
Beste, B., *See* McLaughlin, S.B., 5:34179
Bevilaqua, O.M., *See* Bernard, M.J. III, 5:34111
Bevolo, A.J., *See* Schmidt, F.A., 5:33404
Bhagat, N., Crop residues as a fuel for power generation, 5:33414 (BNL—50982)
Bhatt, B., *See* Fallon, P.T., 5:33196
Bhatt, B.L., *See* Steinberg, M., 5:33210
Bialas, A., Quark model and high-energy nuclear experiments, 5:34356 (LBL—8957, pp 63-113)
Bickes, R.W. Jr., *See* Walko, R.J., 5:34084
Biddle, A.P., Stability and heating of a poloidal divertor tokamak, 5:34435 (DOE/ET/53051—6)
Bierenbaum, H.S., *See* Merriam, R.L., 5:33760
Bifani, A.G., *See* Cecchi, C., 5:34024
Bilotta, R.M., Crossed beam studies of low energy proton transfer reactions: H_2^+ (Ar,H) HAr^+ from 0.4 to 7.8 eV (c.m.), 5:34240
Bindslev Hansen, J., *See* Lindelof, P.E., 5:33997
Bishop, R.C., *See* Gaston, R.J., 5:33232
Blackadar, R.L., *See* Castner, D.G., 5:33203
Blackburn, C.M., Flywheel Seal Test Program, 5:33638 (SAND—80-7019)
Blair, L.M., *See* Gaston, R.J., 5:33232
Blake, C.R., *See* Sugalski, R.K., 5:33656
Blanc, J., *See* Funghnan, B.W., 5:33407
Blaney, T.G., Josephson mixers at submillimetre wavelengths: present experimental status and future developments, 5:33986

Blanpied, G.S., *See* Burleson, G.R., 5:34318
Blanton, W.A. Jr., Sulfur oxides control in catalytic cracking, 5:33272
Blazey, K.W., Temperature dependence of anomalous muonium hyperfine interactions in silicon, 5:34251 (LA-UR—80-2373)
Block, R.F., *See* Hunter, V.R., 5:33640
Blocker, T.G., Advanced imaging techniques for submicrometer devices, 5:33992
Blomeke, J.O., *See* Carter, W.L., 5:33314
Blum, N.A., *See* Feldman, C., 5:33411
Blumberg, A.Y., Comparison of soil surface arthropod populations in conventional tillage, no-tillage and old field systems, 5:34182 (DOE/EV/00641—41)
Bodmer, A.R., Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361
Bodmer-Turner, S., *See* Sheridan, R.J., 5:33771
Boers, J.E., *See* Walko, R.J., 5:34084
Bogner, J.E., *See* Henricks, J.D., 5:33224
Bohachevsky, I.O., *See* Frank, T.G., 5:34423
Bohning, D., *See* Stang, L., 5:33387, 5:34115
Boley, C.D., GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array, 5:34393 (ANL/FPP/TM—135)
Bomar, G.L., *See* Maguire, C.F., 5:34326
Bomberger, D.C., *See* Jones, J.L., 5:33362
Bond, V.P., *See* Varma, M.N., 5:34367
Bonnaterre, R., Nickel-cadmium cell and method for precharging negative electrode of nickel-cadmium alkaline storage cell, 5:33649
Bonner, B.E., *See* Ransome, R.D., 5:34095
Bonnewell, V., *See* Pratt, D.C., 5:33434
Booth, D.C., Chemical vapor deposited amorphous silicon for use in photothermal conversion, 5:33534
Boudard, A., *See* Nefkens, B.M.K., 5:34315
Bourdeau, L.E., Study of two passive solar systems containing phase change materials for thermal storage, 5:33475 (LA-UR—80-1669)
Bourrel, M., Tertiary oil recovery processes. Annual report, October 1978-September 1979, 5:33243 (DOE/BC/20001—6)
Bowen, W.W., *See* Svedberg, R.C., 5:33852
Bowman, J.R., *See* Rohrs D.T., 5:33560
Bowman, K.O., *See* Lam, H., 5:34442
Bowman, M.G., *See* Cox, K.E., 5:33355
Boyce, S.E., *See* Merriam, R.L., 5:33760
Boyd, W.A., *See* Johnson, I., 5:33236
Boyer, D.G., *See* Anderson, D.R., 5:33336
Boykins, C., Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
Boyles, R.A., *See* Banks, D.O., 5:34022
Bradbury, J.C., *See* Glover, T.O., 5:33686
Bradley, E.R., *See* Jones, R.H., 5:33895
Braithwaite, W.J., *See* Burleson, G.R., 5:34318
Brandenburg, G.W., *See* Aitkenhead, W., 5:34296
Braun, G., Description of the solar thermal program, 5:33447 (DOE/JPL—1060-12(Vol.2), pp 11-27)
Braunstein, H.M., Environmental and health aspects of biomass energy systems, 5:34116 (CONF-800814—11)
Bray, D.J., Creep of 90+ % Al_2O_3 refractory concrete, 5:33904
Brench, B.L., Snow-covering effects on the power output of solar photovoltaic arrays, 5:33443 (COO—4094-61)
Brenden, B.B., Measuring transient high temperature thermal phenomena in hostile environment, 5:33863 (PNL-SA—8295)
Brendmoen, J.V., Measurements of jet dispersions simulated in an aeronautical wind tunnel, 5:34114 (AD-A—076578)
Brenner, A.E., *See* Aitkenhead, W., 5:34296
Brenner, D., *See* Williamson, S.J., 5:33969
Bressler, J.P., Cell culture systems to study glial transformation, 5:34178 (UCLA—12-1261)
Brice, R.S., Performance evolution in a large scale system, 5:34444 (LA-UR—80-1185)
Briggs, T., Industrial hygiene of photovoltaic cell production, 5:33401 (BNL—51118, pp 109-110)
Brimhall, J.L., Effect of He on the swelling/microstructure produced in Mo by ion bombardment, 5:33891
Brinkworth, B.J., Potential for industrial use of solar energy in the United Kingdom, 5:33505
Briscoe, W.J., *See* Nefkens, B.M.K., 5:34315
Bristeau, P., *See* Lambert, G., 5:34230
Bristowe, P.D., Simulation of the structure of vacancies in high angle grain boundaries, 5:33855
Brodsky, M.B., Observation of a strongly enhanced magnetic susceptibility of Pd in Au-Pd-Au sandwiches, 5:33881
Brodsky, S.J., Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957, pp 419-464)
Broers, A.N., High resolution electron beam lithography and applications to superconducting devices, 5:33993
Brokman, A., *See* Bristowe, P.D., 5:33855
Bromberg, C., *See* Lowenstein, D.I., 5:34270
Brook, J.W., The jet membrane process for uranium separation and enrichment. Final report on phase 2, 5:33305 (AD-A—076907)
Brown, Energy Recovery from Waste and Biomass Project, 5:34062
Brown, B.C., *See* Yamanouchi, T., 5:34281
Brown, C.M., *See* Taboas, A.L., 5:33328
Brown, C.N., *See* Yamanouchi, T., 5:34281
Brown, D.A., Adsorption and diffusion of plutonium in soil, 5:34152 (DOE/EV/04700—T1)
Brown, J.A., *See* Blazey, K.W., 5:34251
See Vanderwater, D.A., 5:34252
Brown, R.E., Differential cross sections for p + ^{3}He scattering from 19.5 to 47.5 MeV, 5:34313 (LA—8179-MS)
See Flynn, E.R., 5:34328
See Hardekopf, R.A., 5:34325
Brown, S., Carbon Dioxide Effects Research and Assessment Program. The role of tropical forests on the world carbon cycle, 5:34148 (CONF-800350—)
Brown, W.M., Future role of geopressured resources in US energy policy: a scenario approach and analysis. Final report, July 1, 1978-March 31, 1979, 5:33286 (COO—4955-1)
Browne, *See* Howe, 5:34348
See White, 5:34347
Browne, S., *See* Kai, K., 5:33699
Bruce, R.W., Survey of needs for energy storage in a solar thermal electric power plant, 5:33448 (DOE/JPL—1060-12(Vol.2), pp 39-46)
Bruckner, L.A., Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
Bruge, G., *See* Nefkens, B.M.K., 5:34315
Bruns, J.J., Study of midwestern bituminous coal fly ash, 5:33215 (IS-T—923)
Bruns, L.E., Transmutation of radwaste using accelerators, 5:33321 (RHO-SA—174)
Bryant, B., *See* Koontz, R., 5:33484
Bryson, M.C., Reliability problems in power-generation systems, 5:33736 (LA-UR—80-2354)
Bucciarelli, L.L., Dynamic analysis of a magnetically suspended energy storage wheel, 5:33637 (DOE/ET/20279—102)
Bucelot, T.J., *See* Deaver, B.S. Jr., 5:33965
Buchsbaum, S., *See* Bernow, S.S., 5:33801
Buckman, R.W. Jr., *See* Svedberg, R.C., 5:33852
Buitrago, R., Surfaces of high-T/sub c/ Nb_3Ge films as studied by electron tunneling and auger electron spectroscopy, 5:34009
Bulvid, M.G., *See* Ashare, E., 5:33431
Bulatov, O.G., dc thyristor-capacitor converter for an electric automobile, 5:33827 (DOE-tr—232)
Bullington, D.C., *See* Bergvall, J.A., 5:33366
Burden, J.E., *See* Haywood, F.F., 5:34151
Burke, D.G., *See* Straume, O., 5:34334
Burke, J.R., Advanced research and development on photovoltaic materials, 5:33395 (BNL—51118, pp 62-72)
Burleson, G.R., Isospin quintets in the 1p and s-d shells, 5:34318
Burnet, G., Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
See Murtha, M.J., 5:33222
Burns, C.C., *See* Reiter, E.R., 5:34113
Burns, E.J.T., *See* Clauser, M.J., 5:34432
Burns, E.T., *See* Land, R., 5:33734
Burow, D.F., Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
Burrell, C.F., *See* Hooper, E.B. Jr, 5:34077
Burrell, K.H., Alteration of Pfirsch—Schlueter transport in tokamaks by all four external sources, 5:34405
Burton, G.W., Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Annual progress report, November 1, 1979 to October 31, 1980, 5:34181 (DOE/EV/00637—9)
Busness, K.M., *See* Easter, R.C., 5:34121
Busza, W., *See* Aitkenhead, W., 5:34296
Buttermore, W.H., *See* Slonaker, J.F., 5:33219
Butz, T.R., Stream sediment detailed geochemical survey for Date Creek Basin, Arizona, 5:33304 (GJBX—164(80))
Buzard, K., *See* Abraham, B.M., 5:34101
Buzbee, B.L., Implementing techniques for elliptic problems on vector processors, 5:34446 (LA-UR—80-2343)
Buzzelli, E.S., Iron/air battery system having circulating electrolyte and a horizontal cell configuration, 5:33648
Byster, S.E., Dissolution of HTGR TRISO beads by the alkali fluoride fusion method, 5:33308 (NBL—296)

C

Cabrera, B., Application of SQUIDs to measurements in fundamental physics, 5:33966
Signal detection in 1/f noise of SQUID magnetometers, 5:33977
Cahn, D.F., Computer-aided visualization of database structural relationships, 5:34458 (LBL—10437)
Caird, R.S., *See* Fowler, C.M., 5:34370
Calcagno, P.L., *See* Sulek, K., 5:34189
Caldwell, *See* Brown, 5:34062

Caldwell, D.E., *See* Barnhart, B.J., 5:33324
Caldwell, P.J., *See* Arakawa, E.T., 5:34097
Calia, V., *See* Brook, J.W., 5:33305
Call, W.R., *See* Batzer, T.H., 5:34437
Calm, J.M., Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles, 5:33802 (ANL/CNSV-TM—40)
Calogeras, J.E., Need for specific requirements by storage system development teams, 5:33544 (DOE/JPL—1060-12(Vol.2), pp 267-275)
Campbell, E.W., *See* Barnhart, B.J., 5:33324
Campbell, R.B., Phase 2 of the array automated assembly task for the Low Cost Solar Array Project. Final report, October 1, 1978-October 30, 1979, 5:33403 (DOE/JPL/954873—8)
Campisi, G.J., *See* Schmidt, F.A., 5:33404
Cannell, G.H., *See* Felker, P., 5:34180
Cannon, C., *See* Deno, N.C., 5:33200
Cantley, D.A., *See* Einziger, R.E., 5:33310
Capelle, G., *See* Franks, L., 5:34098
Capuano, R.M., *See* Glenn, W.E., 5:33555
Cardenas, M., *See* Ortiz, M.E., 5:34322
Carey, D.C., *See* Aitkenhead, W., 5:34296
Carlson, M.C.J., Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
Carr, J.E., *See* Merriam, R.L., 5:33760
Carroll, W.F., Polymers in solar technologies: an R and D strategy, 5:33521 (SERI/TR—334-601)
Carroll, W.L., Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
See Condon, P.E., 5:33766
Carter, L.L., *See* Mann, F.M., 5:34082
Carter, W.L., Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
Carver, G.E., Chemical vapor deposited molybdenum films for use in photothermal conversion, 5:33533
Case, G.L., Solar energy in Australia: a profile of renewable energy activity in its national context, 5:33377 (SERI/SP—763-717)
Caskey, G.R. Jr., *See* Dietrich, M.R., 5:33861
Castel, B., *See* Halderson, D., 5:34324
Castle, J., SERAPH facility capabilities, 5:33504 (SERI/RR—632-702)
Castner, D.G., CO hydrogenation over rhodium foil and single crystal catalysts: correlations of catalyst activity, selectivity, and surface composition, 5:33203
Catizone, P.A., *See* Pocalujka, L.P., 5:33339
Cattano, J.D., Battery strap and post cast-on multi use mold, 5:33653
Caunt, J.W., *See* Forman, S.E., 5:33402
Cavin, W.D., *See* Johnson, D.W., 5:33270
Cecchi, C., Pipe-laying machine for oil pipelines, conduits and the like, 5:34024
Chan, S.H., *See* Chawla, T.C., 5:34037, 5:34043
Chang, B.H., Thermal cracking of gas oil to middle distillate, 5:33261
Chang, C.C., *See* Holdeman, L.B., 5:33980
Chang, J., *See* Clauser, M.J., 5:34432
Chang, R.P.H., *See* Ono, M., 5:34409, 5:34410
Chapman, D.S., *See* Glenn, W.E., 5:33555
Charlot, L.A., *See* Brimhall, J.L., 5:33891
Chase, A.B., *See* Silver, A.H., 5:34004
Chastagner, P., Direct determination of cesium in pilot plant effluents by isotope dilution mass spectrometry, 5:33925 (DP-MS—80-17)
Chaturvedi, S.K., *See* Porter, R.W., 5:34035
Chawla, T.C., Combined natural convection and radiation in a volumetrically heated fluid layer, 5:34043
Combined radiation convection in thermally developing Poiseuille flow with scattering, 5:34037
Chekhovoy, Yu.N., Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control, 5:33830 (DOE-tr—237)
Chen, E.P., Transient response of a single-edge crack in an elastic half-plane, 5:33955 (SAND—80-1877C)
Cheng, E.T., Safety and personnel access aspects of low activation fusion blankets, 5:34418 (CONF-801011—1)
Cheng, K.T., *See* Johnson, W.R., 5:34243
Chernov, G.M., *See* Azimov, S.A., 5:34363
Chester, K.A., *See* AdT. R.R. Jr., 5:33848
Cheung, F.B., Boundary layer behavior in transient turbulent thermal convection flow, 5:34040
See Chawla, T.C., 5:34043
Chevion, M., *See* Samuni, A., 5:34184
Chew, C.K., Particle ratios, quarks, and Chao-Yang statistics, 5:34287
Chew, H.W., *See* Wang, D., 5:34391
Chiang, I-H., Search for narrow states produced in the reaction $\pi^- p \rightarrow n +$ γ's at 13 GeV/c, 5:34284 (BNL—28057)
Chiao, R.Y., Phase instability noise in Josephson junctions, 5:33989
Chiaradia, M.T., *See* Aitkenhead, W., 5:34296
Child, H.R., New small-angle neutron scattering (SANS) instrument at ORNL using a position-sensitive area detector, 5:34090
Child, W.C., *See* Smith, D.H., 5:33929
Chilenskas, A.A., *See* Zivi, S.M., 5:33593
Chilton, P.D., *See* Johnson, D.W., 5:33270
Chiotti, P., Adsorption of moisture by grain dust and control of dust hazards, 5:34124 (IS-M—285)
Cho, D.H., *See* Chawla, T.C., 5:34043
Christ, N.H., Operator ordering and Feynman rules in gauge theories, 5:34305
Christensen, C.P., Investigation of surface-stabilized high-pressure gas discharges. Final report, 22 May 1978-21 May 1979, 5:34029 (AD-A—077040)
Christensen, E.L., *See* Ramsey, H.D., 5:33928
Christiansen, J.P., *See* Turner, L., 5:34402
Christopher, D.H., *See* Durkin, P.R., 5:34199
Christophorou, L.G., High voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, October 1, 1979-March 31, 1980, 5:34238 (ORNL/TM—7405)
Chung, D.H., *See* Bernreuter, D.L., 5:33634
Chung, K.E., Chemical characterization of a hvb coal, 5:33217
Church, H.W., *See* Pocalujka, L.P., 5:33339
Chymko, N.R., *See* Jantzie, T., 5:34202
Chynoweth, D.P., Anaerobic digestion of kelp, 5:33427 (NP—25045)
Cizewski, J.A., *See* Flynn, E.R., 5:34328
Clague, R.E., Lead-acid storage battery having Pb-Cd-Zn-Sn plate straps, 5:33660
Claiborne, H.C., Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
Clappier, R.R., *See* Anderson, J.T., 5:33976
Clark, A., *See* Messina, M.G., 5:33435
Clark, M.T., *See* Nelson, W.R., 5:33629
Clark, P.R., *See* Felker, P., 5:34180
Clarke, J., Fluctuation analysis, 5:34381 (LBL—11055)
SQUIDs and magnetotellurics with a remote reference, 5:33967
See Ketchen, M.B., 5:33963
Clarkson, T.W., In vitro tests and morbidity in man: special characteristics of inorganic materials, 5:34213 (BNL—51118, pp 250-264)
Clauser, M.J., Particle beam interactions with plasmas and their application to inertial fusion, 5:34432
Clay, F.A., Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
Clemente, F., Sociological implications of an energy-deficient society, 5:33669 (CONF-800212—, pp 35-43)
Clemot, M.G., Contribution of solar energy to the development of arid zones: experience of solar assisted mechanical and electrical systems for industrial and agricultural processes, 5:33454
Clifford, J.E., Review of state-of-the-art of solar collector corrosion processes. Task 1 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33517 (DOE/CS/10510—T12)
See Diegle, R.B., 5:33516
Clifton, D.G., *See* Ramsey, H.D., 5:33928
Cobble, M.H., Analysis of a Cassegrain solar furnace, 5:33511
Cochrane, H., *See* Reiter, E.R., 5:34113
Cocke, C.L., *See* Gray, T.J., 5:34258
Coe, B.A., Regulation of geothermal energy development in Colorado, 5:33566 (DOE/ID/12018—2)
Cogdell, J.W., *See* Feuer, M.D., 5:33996
Cohen, M.L., Comment on "Quantum photoyield of diamond (111): A stable negative-affinity emitter", 5:33919
Cohen, S., *See* Crocker, J.G., 5:34420
Cole, D., *See* Glenn, W.E., 5:33555
Cole, R., *See* Bressler, J.P., 5:34178
Coleman, S., Chiral-symmetry breakdown in large-N chromodynamics, 5:34298
Colgate, S.A., Luminosity of type I supernovae, 5:34235
^{56}Ni and the light curve of Type I supernova, 5:34233 (LA-UR—80-2197)
Collins, J.F., *See* Mueller, P.K., 5:34120
Combs, G.F. Jr., Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
Compton, R.N., *See* Cooper, C.D., 5:34246
See Miller, J.C., 5:33921
Concus, P., *See* Albright, N., 5:33247
Condon, P.E., Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
See Sherman, M.H., 5:33780
Connell, J.R., Turbulence spectrum observed by a fast-rotating wind-turbine blade, 5:33584 (PNL—3426)
Connor, K.A., *See* Hickok, R.L., 5:34397
Conzett, H.E., *See* Bacher, A.D., 5:34316
Cook, C.W., Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)
Cook, J.R., Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
Cook, R.J., Theory of resonance-radiation pressure, 5:34264
Cooke, D.W., *See* Blazey, K.W., 5:34251
See Vanderwater, D.A., 5:34252
Cool, R.L., Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)

Cooper, C.D., Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan, 5:34246
Cooper, F., *See* Bender, C.M., 5:34389
Cooper, R.K., *See* Lawrence, G.P., 5:34086
Copeland, R.J., Preliminary requirements for thermal storage subsystems in solar thermal applications, 5:33546 (SERI/RR—731-364)
Corden, M.E., *See* Graham, R.D., 5:33604
Corliss, L.M., *See* Hastings, J.M., 5:33873
Correll, F.D., *See* Hardekopf, R.A., 5:34325
Costrell, L., Germanium semiconductor detector efficiency determination using a standard Marinelli (reentrant) beaker geometry, 5:34091
Cottingame, W.B., *See* Burleson, G.R., 5:34318
Coughlin, R.W., Electrochemical route to coal gasification and its technological implications, 5:33195
Courant, E.D., Tacoma mode, 5:34069 (BNL—27972)
Court, G.J., Collection, purification, and culture of cyanobacteria, 5:34156 (BNL—28136)
Coutant, C.C., *See* Schaich, B.A., 5:34158
Couturie, S., *See* Suits, B.H., 5:33875
Cowgill, D.F., *See* Walko, R.J., 5:34084
Cox, B.L., Ductility in bending of molybdenum alloys irradiated between 425 and 1000°C, 5:33892
Cox, F.W., Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—, pp II.22.1-II.22.14)
Cox, K.E., LASL thermochemical hydrogen program status on September 30, 1980, 5:33355 (LA-UR—80-2400)
Craig, G.T., *See* Garrison, J.D., 5:33532
Cramer, W.E., Nomograms for overpressure, fireball radius and thermal energy of nuclear weapons. Technical information series, 5:34107 (AD-A—076489)
Crandall, J.L., National perspective on waste management, 5:33313 (DP-MS—80-73)
Crandall, K.R., *See* Stokes, R.H., 5:34074
Crawford, M., *See* Schramm, D.N., 5:34234
Crecraft, H.R., Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
Cringle, D.C., *See* Pearce, R.L., 5:33281
Crocker, J.G., Fusion Reactor Safety Research Program annual report, FY-79, 5:34420 (EGG—2018)
Cronholm, L.A., *See* Margen, P., 5:33806
Cronin, J., *See* Dethlefsen, R., 5:33605
Crooks, G., *See* Martin, P., 5:33583
Crossley, D.A. Jr., Mineral cycling in soil and litter arthropod food chains. Progress report, November 1, 1979-October 31, 1980, 5:34149 (DOE/EV/00641—37)
See Abbott, D.T., 5:34171
See Blumberg, A.Y., 5:34182
Crossley, D.J., Energy policy in Australia: the social/institutional context and procedures for policy formulation, 5:33703
Energy use and human life styles, 5:33677
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
Crowe, B.M., Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
Cuming, M.J., *See* Holl, M.M., 5:34231
Cuozzo, L., Solar tobacco drying plant, 5:33506
Currey, F.E., *See* Healey, D.L., 5:34224
Curry, K., *See* Deno, N.C., 5:33199, 5:33200
Curry, W.H., Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
Curtis, C.W., Effect of solvent quality on coal conversion, 5:33204
See Garg, D., 5:33208
Curtis, D.B., Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
Cutts, D., *See* Aitkenhead, W., 5:34296
Czapski, G., Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Annual progress report, September 1979-July 1980, 5:33937 (DOE/EV/03221—67)
See Samuni, A., 5:34184
Czarnecki, R.J., *See* Ammerlaan, A.C.F., 5:33578

D

D'Aiello, R.V., Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 3, 25 March-24 June 1980, 5:33406 (SERI/PR—0-8274-3)
D'Antonio, P., Radial distribution least-squares program (RADILS) users manual. Memorandum report, 5:33924 (AD-A—076964)
Daalmans, G.M., Alternatives in fabricating submicron niobium Josephson junctions, 5:33995
Dacal, A., *See* Ortiz, M.E., 5:34322
Dailey, N.S., *See* Nakamura, S.L., 5:33596
Dale, S.J., Superposition gas breakdown. Final report, 5:33601 (EPRI-EL—1484)
Daly, L.A., *See* Guth, E.D., 5:33356
Dammann, J.C., Economies in fuel wood supply firms in New Hampshire, 5:33436
See Andrews, R.A., 5:33439
Dang, G.D., Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
Daniel, M.R., Biasing for precise frequency in a frequency-agile Josephson junction, 5:33983
Daniele, C.J., Preliminary results from a four-working space, double-acting piston, Stirling engine controls model, 5:33822 (DOE/NASA/1040—17)
Danielson, M.J., Development of the high-temperature redox electrode. Interim report ending March 1980, 5:33564 (PNL—3377)
DasGupta, A., *See* Koch, C.C., 5:33906
Davidheiser, R.A., Superconducting microstrip filters, 5:33984
Davidson, G.A., Maddukuri, C.S., *See* Slawson, P.R., 5:34127
Davis, G.K., Possible adverse effects of trace materials, 5:34206 (BNL—51118, pp 234-242)
Davis, J.R., *See* Campbell, R.B., 5:33403
Davis, R.F., *See* Mills, K.A., 5:33877
Davis, W.E., Use of time averaged precipitation for wet removal in a regional air pollution assessment model, 5:34129 (PNL-SA—7658)
Davitian, H., *See* Bhagat, N., 5:33414
Daw, G.H., *See* Burleson, G.R., 5:34318
Dayan, M., *See* Buitrago, R., 5:34009
de Boor, C., Collocation approximation to eigenvalues of an ordinary differential equation: The principle of the thing, 5:34454
de Guerra, E.M., Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
de Llano, M., *See* Aguilera-Navarro, V.C., 5:34350
de Mello, F.P., Determination of synchronous machine stability study constants. Final report, 5:33591 (EPRI-EL—1424(Vol.3))
de Nora, V., Halogen electrodes and storage batteries, 5:33662
de Swiniarski, R., *See* Bacher, A.D., 5:34316
de Vellis, J., *See* Bressler, J.P., 5:34178
Deaver, B.S. Jr., Future trends in superconductive electronics, (Charlottesville, 1978), 5:33961
SQUIDs for measuring the magnetic properties of materials, 5:33965
See Barr, D.W., 5:34001
See Galfo, C.H., 5:34002
Debenham, P.H., *See* Penner, S., 5:34083
Dehan, L., *See* Benshan, W., 5:33242
del Campo, J.G., *See* Maguire, C.F., 5:34326
See Ortiz, M.E., 5:34322
Delagrange, H., *See* Logan, D., 5:34336
Deleplanque, M.A., Correlation studies of rotational behavior at very high angular momentum, 5:34340
Delheij, P.P.J., Polarized targets and polarized low energy neutrons at WNR, 5:34366 (LA-UR—80-1933)
DeMarzo, C., *See* Aitkenhead, W., 5:34296
Deno, N.C., Aliphatic components of coal. Quarterly report, March-June 1980, 5:33200 (DOE/ET/13381—T2)
Low temperature chemical fragmentation of coal, 5:33199 (DOE/ET/13381—T1)
Derr, V., *See* Lerfald, G., 5:33383
DesJardin, R., Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
Dethlefsen, R., High-temperature gas-insulated systems. Final report, 5:33605 (EPRI-EL—1500)
Deuchler, W., *See* Barr, R., 5:33458
Deutscher, G., Granular superconductors for SQUIDs, 5:34008
Deutscher, S.B., *See* Morgan, R.J., 5:33909
DeVries, R.M., Nucleus-nucleus total reaction cross sections, 5:34317
Dexter, R.N., *See* Biddle, A.P., 5:34435
Diamond, R.M., *See* Deleplanque, M.A., 5:34340
Dickens, J.K., Gamma rays following alpha decay of ^{248}Cm and the level structure of ^{241}Pu, 5:34344
Dicks, A.S., *See* Shields, J.D., 5:34154
Diegle, R.B., Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
See Beavers, J.A., 5:33515
See Clifford, J.E., 5:33517
Dienes, M., *See* Stang, L., 5:33387, 5:34115
Dietrich, D.D., Radiative decay of the 2p ^{2}P/sub 3/2,1/2/ states of lithiumlike krypton (Z=36) and the 2s 2p $^3P_1$ state of berylliumlike krypton, 5:34244
Dietrich, M.R., J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
Dilanyan, E.M., Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles, 5:33832 (DOE-tr—239)
DiNanno, L., *See* Koplow, M.D., 5:33820
Ding, Y.H., Further study of the variability in the frequency of typhoon formation over the West Pacific ocean, 5:34112 (COO—1340-75)
DiPippo, R., Geothermal energy as a source of electricity. A worldwide survey of the design and operation of

geothermal power plants, 5:33568 (DOE/RA/28320—1)
Dmitrenko, V.E., *See* Lidorenko, N.S., 5:33826
Dobrowolski, T., *See* Aitkenhead, W., 5:34296
Doctor, R.D., Solar energy economics for the county of Santa Barbara, 5:33510 (NP—25017)
Dodd, H.M., Systems analyses of storage in specific solar thermal power applications, 5:33542 (DOE/JPL—1060-12(Vol.2), pp 199-212)
Dodds, S.A., *See* Blazey, K.W., 5:34251
See Schillaci, M.E., 5:34254
See Vanderwater, D.A., 5:34252
Dodson, B.W., *See* Graham, R.A., 5:33931
Doepken, H.C. Jr., *See* Kiss, K.D., 5:33603
Donabedian, M., Thermal storage cost/temperature tradeoffs for Solar Total Energy Systems (STES), 5:33456 (DOE/JPL—1060-12(Vol.2), pp 139-167)
Donaldson, G.B., Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010
Donaldson, G.J., Ratio of D^0 and D^+ lifetimes from their semileptonic decays, 5:34280 (SLAC-PUB—2532)
Donovan, J.A., *See* Dietrich, M.R., 5:33861
Dossing, T., *See* Neergard, K., 5:34330
Dougan, *See* Howe, 5:34348
Douglas-Hamilton, D.H., Investigation of the production of high density uniform plasmas. Volume I. Final report, 2 April 1978-2 April 1979, 5:34027 (AD-A—076492)
Downey, W.T., *See* Vachon, W.A., 5:33586
Doyle, T.W., *See* Shugart, H.H., 5:34145
Drake, R.L., Hybrid regional air pollution models, 5:34131 (PNL-SA—8431)
Dresner, L., Calculation of similarity solutions of partial differential equations, 5:34403 (ORNL/TM—7407)
Dressel, W.M., Minerals in the economy of Missouri, 5:33683
Drinka, T.P., *See* Baumel, C.P., 5:33234
Dryer, F.L., *See* Westbrook, C.K., 5:33358
Dubay, G.R., Cyano-arenes produced by combustion of nitrogen-containing fuels, 5:33175
DuBois, S., *See* Haines, B.L., 5:34117
Duek, E., *See* Logan, D., 5:34336
Duering, K., Transport and distribution costs of conventional heat-supply systems in the Federal Republic of Germany. Applied Systems Analysis report No. 13, 5:33761 (Juel-Spez—57)
Dulude, R.S., *See* Aitkenhead, W., 5:34296
Dunkerley, J., Trends in energy use in industrial societies. Final report, 5:33742 (EPRI-EA—1471)
Dunkleberger, L.N., *See* Magerlein, J.H., 5:34015
Dunn, E.D., *See* van Dyck, O.B., 5:34066, 5:34250
Dunning, D.E., *See* Yalcintas, M.G., 5:34185
Dupzyk, *See* Howe, 5:34348
Duraiswamy, K., Pyrolysis and hydrogenation process, 5:33180
Durand, P., Electrochemical generators with auxiliary cathode, 5:33650
Durkin, P.R., Reviews of the environmental effects of pollutants. X. Toxaphene, 5:34199 (ORNL/EIS—130)
Durrill, D.C., Spent fuel handling and packaging program. Quarterly report, April-June 1980, 5:33309 (DOE/NV/10061—3)
Dylla, H.F., *See* Staib, P., 5:34398

E

Eadie, W.J., *See* Davis, W.E., 5:34129
Easley, C.E., *See* Moon, G.D. Jr., 5:33416
Easter, R.C., Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
Easterling, J., Summary of the DPR, 5:33392 (SERI/TR—733-394)
Eastman, C., Attitudes toward energy use and policy in New Mexico, 5:33818
Eberle, W.J., Apparatus and method for stacking battery plates and separators, 5:33646
Eberly, J.H., Influence of propagation on off-resonant molecular excitation, 5:34365 (UCRL—84259(Rev.1))
Eby, R.J., Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant, 5:33185 (FE—2012-096(App.))
Pipeline Gas Demonstration Plant. Phase I. Process evaluation report, conceptual commercial plant, 5:33186 (FE—2012-096(Sect.4))
Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant, 5:33189 (FE—2012-096(Sect.1)(Exec.Summ.))
Eby, R.L., Method and apparatus for determining the capacity of lead acid storage batteries, 5:33652
Eccleston, D.B., *See* Allsup, J.R., 5:33840
Ecklund, E.E., Alcohol/gasoline reliability fleet tests: a US Federal project, 5:33842 (CONF-790520—, pp II.20.1-II.20.10)
Legal and regulatory influences on alcohol fuels use in the United States, 5:33417 (CONF-790520—, pp II.44.1-II.44.10)
Edwards, G.W., *See* Samaga, B.S., 5:33843
Eggers, S.J., Efficient access of compressed data, 5:34459 (LBL—10648)
Eichelberger, J.R., Strategic petroleum reserve crude oil data search file documentation. Final report, June 1978-September 1979, 5:33278 (AD-A—076949)
Einziger, R.E., Spent fuel resistance to internally produced cladding degradation, 5:33310 (HEDL-SA—2138)
Eisenhawer, S.W., *See* Lyle, W.D., 5:33249
Eklund, N., Computational experience with an explicit difference scheme for a one phase Stefan problem, 5:34388 (ORNL/CSD—62)
Eldredge, L.L., Large scale solar heating and air conditioning in the United States, 5:33524
Elias, J.E., *See* Aitkenhead, W., 5:34296
Ellegaard, C., *See* Deleplanque, M.A., 5:34340
Elleman, T., Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
Ellis, B.S., *See* Haywood, F.F., 5:34151
Emery, J.C., *See* Nieves, L.A., 5:33592
Endlich, R., *See* Martin, P., 5:33583
Endo, T., *See* Koyanagi, M., 5:33981
Englehardt, J., Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979, 5:33602 (CONS—3122-T2)
Englesson, G.A., Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—, pp 183-203)
Engstrom, H., *See* Bates, J.B., 5:34245
Epstein, B.G., Analytic study of azimuthal asymmetries in relativistic hollow e-beams, 5:34241
Epstein, M., Transient solidification in flow into a rod bundle, 5:34038
Epworth, R.W., *See* Hu, E.L., 5:34005
Erickson, D.J., *See* Fowler, C.M., 5:34370
Erickson, J.J., Quality control of software in dissimilar systems using a common clinical data base, 5:34173 (DOE/EV/10343—4)
Ericson, D.M. Jr., Design concepts to enhance nuclear power plant protection, 5:33612 (SAND—80-1428C)
Erikson, A.L., *See* Maeck, W.J., 5:33617
Erikson, R.L., Experimental study of the response of the Galesville sandstone to simulated CAES conditions, 5:33635 (PNL—3399)
Erley, D., Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
Erskine, D., *See* Muller, T., 5:33513
Escher, W.J.D., Solar/hydrogen systems technologies. Volume II (Part 1 of 2). Solar/hydrogen systems assessment. Final report, 5:33350 (DOE/JPL—955492(Vol.2)(Pt.1))
Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report, 5:33351 (DOE/JPL—955492(Vol.2)(Pt.2))
See Foster, R.W., 5:33353
Esterl, D.J., *See* Hartley, J.N., 5:33317, 5:33319
Estle, T.L., Review of the experimental results on impurity centers in elemental semiconductors obtained by μSR and other techniques, 5:34255 (LA-UR—80-2377)
See Blazey, K.W., 5:34251
See Schillaci, M.E., 5:34254
See Vanderwater, D.A., 5:34252
Evans, D.J., Fluctuation expressions for nonequilibrium distribution functions in adiabatic flows, 5:34267
Evans, S.H. Jr., Summary of potassium/argon age dating, 1979, 5:33551 (DOE/ET/28392—41)
See Crecraft, H.R., 5:33553
Ewbank, W.B., Recent references, 5:34310

F

Faber, V., Block relaxation strategies, 5:34445 (LA-UR—80-2342)
Faehl, R.J., Preliminary simulation studies of accelerator cavity loading, 5:34072 (LA—8405-MS)
Faessler, M.A., Multiplicity correlations in high-energy hadron-nucleus collisions, 5:34342 (LBL—8957, pp 115-138)
Faghihi-Nejad, H., *See* Donaldson, G.B., 5:34010
Fajer, J., *See* Netzel, T.L., 5:34167
Falco, C.M., *See* Deaver, B.S. Jr., 5:33961
Falicov, L.M., *See* Joos, B., 5:33880
Fallon, P., *See* Steinberg, M., 5:33210
Fallon, P.T., Flash hydropyrolysis of lignite and sub-bituminous coals to both liquid and gaseous hydrocarbon products, 5:33196
Farahbakhshian, N., Forecasting higher order statistical moments and probability densities for power system loads by the method of time series, 5:33701 (PCTR—92-80)
Farkas, Z.D., RF Energy Compressor, 5:34059 (SLAC-PUB—2480)
Farnsworth, A.V. Jr., Power-driven and adiabatic expansions into vacuum, 5:34428

Farnum, B.W., Products of liquefaction of lignite with synthesis gas by product slurry recycle, 5:33205
Farooque, M., *See* Coughlin, R.W., 5:33195
Farrar, J.M., *See* Bilotta, R.M., 5:34240
Farrell, K., *See* Maziasz, P.J., 5:33898
Fasching, G.E., Single transmission line interrogated multiple channel data acquisition system, 5:34456
Faulkner, R., Technology: today's blue chip, 5:33688 (CONF-800212—, pp 53-58)
Faure, J.L., *See* Nefkens, B.M.K., 5:34315
Favuzzi, C., *See* Aitkenhead, W., 5:34296
Fay, W.M., Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
Fearon, E.M., *See* Souers, P.C., 5:33346
Feldman, A., *See* Waxler, R.M., 5:33918
Feldman, C., Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly report, 1 April-30 June 1980, 5:33411 (SERI/PR—8278-1-T3)
Feldman, G.J., PSI radiative decays, 5:34291 (SLAC-PUB—2510)
Feldman, M.J., *See* Chiao, R.Y., 5:33989
Felker, P., Methods for acquisition, storage, and evaluation of leguminous tree germplasm, 5:34143 (CONF-8006101—1)
Nitrogen cycling: water use efficiency interactions in semi-arid ecosystems in relation to management of tree legumes (Prosopis), 5:34180 (CONF-8004108—1)
Uses of tree legumes in semi-arid regions, 5:33420 (CONF-8006100—1)
Feng, P.K., *See* Johnson, A.J., 5:33320
Fenimore, E.E., Coded aperture imaging: the modulation transfer function for uniformly redundant arrays, 5:34387
Ferbel. T., Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957, pp 1-62)
Fernandez, M., *See* Bourrel, M., 5:33243
Feruglio, M., Solar systems for heating and cooling, 5:33489
Feshbach, H., Nuclear physics perspectives on high-energy nuclear collisions, 5:34357 (LBL—8957, pp 261-279)
Feuer, M.D., Fabrication of submicron Josephson microbridges using optical projection lithography and liftoff techniques, 5:33996
Field, B.F., *See* Holdeman, L.B., 5:33980
Finley, J.J., *See* Deaver, B.S. Jr., 5:33965
Finney, B.C., *See* Carter, W.L., 5:33314
Fiory, A.T., *See* Hebard, A.F., 5:34016
Fisch, E.J., Acid gas removal by versatile Shell processes, 5:33283
Fisch, N.J., Methods of driving current by heating a toroidal plasma, 5:34395 (PPPL—1692)
Fisher, D.R., Estimating population health risk from low-level environmental radon, 5:34192 (PNL-SA—8291)
Fitts, C.R., *See* Steinborn, T.L., 5:33337
Flagg, J.F., Hydrocarbon conversion with an acidic multimetallic catalytic composite, 5:33258
Flessner, M.F., *See* Tang, I.N., 5:34161
Fliermans, C.B., *See* Tison, D.L., 5:34194
Flynn, E.R., The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
See Straume, O., 5:34334
Flynn, G.W., *See* Wolk, G.L., 5:34247
Foley, D., *See* Glenn, W.E., 5:33555
Ford, J.L.C. Jr., *See* Maguire, C.F., 5:34326
See Ortiz, M.E., 5:34322
Forman, N.A., *See* Coe, B.A., 5:33566
Forman, S.E., Portable, X-Y translating, infrared microscope for remote inspection of photovoltaic solar arrays, 5:33402 (DOE/ET/20279—101)
Fortner, R.J., *See* Reed, K.J., 5:34260
Fossan, D.B., *See* Deleplanque, M.A., 5:34340
Foster, C.A., *See* Milora, S.L., 5:34417
Foster, R.W., Solar/hydrogen systems for the 1985 to 2000 time frame. Volume I. Solar/hydrogen systems assessment. Final report, 5:33353 (DOE/JPL—955492(Vol.1))
See Escher, W.J.D., 5:33350, 5:33351
Fowler, B.A., Cadmium and arsenic in the environment, 5:34203 (BNL—51118, pp 111-113)
Fowler, C.M., Explosive generation of high magnetic fields in large volumes and solid state applications, 5:34370 (LA-UR—80-2182)
Fowler, J.R., *See* Mosier, J.E., 5:33326
Fox, J.P., Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
Potential uses of spent shale in the treatment of oil shale retort waters, 5:33299 (LBL—11072)
Fox, R.L., *See* Wayland, J.R., 5:33248
Fraley, S.K., Monte Carlo method of solving heat conduction problems, 5:34044
Francis, H.E., *See* Lloyd, W.G., 5:33216
Francis, J.M., Hybrid inverse kinetics method combining the Yang-Albrecht and three point techniques, 5:33620 (HEDL-TME—79-78)
Frank, H., *See* Krauthamer, S., 5:33453
Frank, T.G., Inertial confinement fusion reactor systems, 5:34423 (LA-UR—80-2499)
Franklin, A.L., *See* Geffen, C.A., 5:34218
Franks, L., Laboratory evaluation of an N_2 laser fluorosensor, 5:34098 (EGG—1183-2369)
Fraser, M.D., *See* Szego, G.C., 5:33507
Frayer, J.A., Combination residual oil hydrodesulfurization and catalytic cracking process, 5:33253
Frederick, D.J., *See* Messina, M.G., 5:33435
Freedman, N.S., Cadmium sulfide cells, 5:33400 (BNL—51118, pp 104-106)
Freeman, A.J., *See* Brodsky, M.B., 5:33881
Freeman, B.L., *See* Fowler, C.M., 5:34370
Freeman, H.D., *See* Hartley, J.N., 5:33317, 5:33319
Freeman, J.R., *See* Patterson, E.L., 5:34426
Freeman, R.B., Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)
French, R.E., *See* Curry, W.H., 5:33950
Frey, W.F., *See* McCright, R.D., 5:33575
Freyberg, D.P., *See* Perry, D.L., 5:33938
Friedman, J., Advanced development of a short-residence-time hydrogasifier. Quarterly technical progress report, April 1, 1980-June 30, 1980, 5:33187 (FE—3125-21)
Friedman, J.I., *See* Aitkenhead, W., 5:34296
Friedman, R., BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition, 5:34447 (LBL—10189/1)
Friesen, R.D., *See* Straume, T., 5:34092
Frind, G., *See* Benenson, D.M., 5:33600
Frisch, H., Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957, pp 195-239)
Froehlich, P., Steam generators for industrial-scale power plants, 5:33796 (NP—24980)
Frumkin, H.A., *See* Sullivan, R.F., 5:33295
Fu, Y.C., *See* Hara, T., 5:33206
Fucinari, C.A., Regenerator matrix physical property data, 5:33821 (DOE/NASA/0008—80/11)
Fujita, I., *See* Netzel, T.L., 5:34167
Fukada, T., *See* Tanigawa, S., 5:33625
Fulton, D.L., *See* Adams, P.H., 5:33949
Fulton, T.A., *See* Magerlein, J.H., 5:34015
Funghnan, B.W., Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980, 5:33407 (SERI/PR—0-8276-3)

G

Gabor, G., *See* Nelson, J.E., 5:33943
Gahimer, J., Description of the thermal and thermochemical energy storage program, 5:33642 (DOE/JPL—1060-12(Vol.2), pp 29-37)
Galfo, C.H., Properties of variable thickness bridges on GaAs substrates, 5:34002
Galloway, T.R., *See* Porch, W.M., 5:34133
Galvin, W.E., *See* Gardner, J.R., 5:33184
Gamble, T.D., *See* Clarke, J., 5:33967
Gammage, R.B., *See* Vo-Dinh, T., 5:33240
Gancarz, A.J., *See* Curtis, D.B., 5:33300
Ganic, E.N., Experimental study of falling liquid film breakdown on a horizontal cylinder during heat transfer, 5:34039
See Yung, D., 5:34266
Gant, R.E., Application of Modular Integrated Utility Systems (MIUS) concept as a strategy for urban rehabilitation and redevelopment, 5:33813 (ORNL/HUD/MIUS—53)
Garbincius, P.H., *See* Aitkenhead, W., 5:34296
Garcia, J.D., *See* Reed, K.J., 5:34260
Gardner, J.R., Rockwell Coal Lock Hopper Valve: METC SOA Test Valve No. A-16. State-of-the-art Lock Hopper Valve Testing and Development Project. Summary test report, 5:33184 (DOE/METC/SP—80/8)
Gardner, W.E., *See* Messina, M.G., 5:33435
Garg, D., Selectivity of coal minerals and SRC residue ashes for hydrodesulfurization in the SRC process, 5:33208
Garland, J.C., Application of SQUIDs to low temperature transport physics, 5:33964
Garn, W.B., *See* Fowler, C.M., 5:34370
Garner, F.A., *See* Gelles, D.S., 5:33893
Garnier, J.E., *See* Olsen, L.C., 5:33405
Garrett, J.D., *See* Deleplanque, M.A., 5:34340
Garrett, W., Optical extinction and N2 gas evolution on photodecomposition of Pb(N3)2. Final report, 1972-1975, 5:33935 (AD-A—077110)
Garrett, W.R., *See* Miller, J.C., 5:33921
Garrison, J.D., Comparison of solar thermal energy collection using fixed and tracking collectors, 5:33532
Gartling, D.K., *See* Hickox, C.E., 5:33334
Gass, W.R., Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. First quarterly progress report, October 1-December 31, 1979, 5:33409 (SERI/PR—8119-2-T1)
Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. Second quarterly progress report, January 1-March 31, 1980, 5:33410 (SERI/PR—8119-2-T2)
Gaston, R.J., Coal mine labor productivity: mine-level data from Pike County, Kentucky, and other selected counties, 5:33232 (ORAU—168)
Gayheart, T.R., *See* Gardner, J.R., 5:33184
Gede, V.P., Tritium practices past and present, 5:34023 (UCRL—84318)

Gee, L., *See* Bergvall, J.A., 5:33365, 5:33366
Geffen, C.A., Assessment of the risk of transporting propane by truck and train, 5:34218 (PNL-SA—8202)
Gehrke, R.J., Gamma-ray emission probabilities and half-life of ^{139}Ba, 5:34333
Gelles, D.S., Experimental method to determine the role of helium in neutron-induced microstructural evolution, 5:33893
Genest, M., *See* Koontz, R., 5:33484
Gentry, F.L., Plasma etchback of multilayer printed wiring boards, 5:34051 (BDX—613-2458)
Germinario, G., *See* Aitkenhead, W., 5:34296
Ghosh, S., Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
See Chynoweth, D.P., 5:33427
See Klass, D.L., 5:33418
Giannotti, J., *See* Barr, R., 5:33458
Gibson, J.H., Workshop: data management needs for atmospheric deposition, 5:34122 (EPRI-WS—79-163)
Giffard, R.P., Rf SQUIDs: the state of the science, 5:33962
Gilbert, E.S., Mortality of Hanford radiation workers, 5:34188 (PNL-SA—8110)
See Marks, S., 5:34187
Gildea, P.D., *See* Gede, V.P., 5:34023
Giles, H.N., *See* Eichelberger, J.R., 5:33278
Gillespie, L.K., Deburring: technical capabilities and cost-effective approaches, Lessons 3 and 4, 5:33945 (BDX—613-2373)
Deburring: technical capabilities and cost-effective approaches, Lessons 9 and 10, 5:33947 (BDX—613-2421)
Gillis, R.E., *See* Lawrence, G.P., 5:34086
Giovanielli, D.V., *See* Henderson, D.B., 5:34422
Gladney, E.S., Compilation of elemental concentration data for the United States geological survey's six geochemical exploration reference materials, 5:34229 (LA—8473-MS)
Gladrow, E.M., Hydrocarbon cracking catalyst, 5:33255
Glanzman, V.M., Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979, 5:34108 (USGS-OFR—80-817)
Glavincevski, B.M., *See* Burow, D.F., 5:33179
Glenn, W.E., Geothermal exploration program, Hill Air Force Base, Davis and Weber Counties, Utah, 5:33555 (DOE/ET/28392—42)
See Atwood, J.W., 5:33563
Glesk, M.M., Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
Glover, T.O., Minerals in the economy of Illinois, 5:33686
Gnanam, A., Biological applications of solar energy, 5:33428
Goblirsch, G., Atmospheric Fluidized Bed Combustion testing of North Dakota lignite, 5:33227 (CONF-800428—7)
Golay, M.W., *See* Todreas, N.E., 5:33616
Goldhaber, G., Charmed mesons produced in e^+e^- annihilations, 5:34277
Goldman, A.M., Electrical analog of a Josephson junction, 5:34377 (DOE/ER/01569—146)
Experimental studies in solid state and low temperature physics. Final report for 1966-1980, 5:34378 (DOE/ER/01569—147)
See Buitrago, R., 5:34009
Goldschmied, F.R., Air/gas system dynamics of fossil fuel power plants. Volume 2. Mathematical system analysis. Final report, 5:33590 (EPRI-CS—1444(Vol.2))
Goldstein, L.H., *See* Acken, J.M., 5:34058
Goldstein, S.A., *See* Ottinger, P.F., 5:34424
Golestaneh, A.A., Comments on the thermal efficiency of an ideal shape-recovery cycle, 5:33864
Goo, E.K.W., Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
Goodman, C.D., *See* Wharton, W.R., 5:34323
Gopala Krishnan, K.V., *See* Samaga, B.S., 5:33843
Gordon, H., Uranium scintillator calorimeter at the CERN ISR, 5:34080 (BNL—28214)
Gordon, H.A., New ideas in calorimetry, 5:34093 (BNL—28132)
Gordon, L.H., High temperature storage technologies for solar thermal applications, 5:33541 (DOE/JPL—1060-12(Vol.2), pp 48-62)
Goree, W., Commercial superconducting SQUID systems, 5:33971
Gormely, R.J., *See* Rao, V.U.S., 5:33191
Gosset, J., *See* Nefkens, B.M.K., 5:34315
Goubau, W.M., *See* Clarke, J., 5:33967
See Ketchen, M.B., 5:33963
Gould, H., *See* Dietrich, D.D., 5:34244
Goulianos, K., *See* Cool, R.L., 5:34272
Gourley, P.L., Kinetics of excitons, biexcitons and free carriers in Si, 5:34373 (SAND—80-1697C)
Grace, A., *See* Easterling, J., 5:33392
Gracia, A., *See* Bourrel, M., 5:33243
Grad, H., Alternating dimension plasma transport in three dimensions, 5:34400 (COO—3077-164)
Graham, R.A., Bibliography on shock-induced chemistry, 5:33931 (SAND—80-1642)
See Carlson, M.C.J., 5:33619
Graham, R.D., Controlling biological deterioration of wood with volatile chemicals. Final report, 5:33604 (EPRI-EL—1480)
Graham, T.E., Process for hydrogen recovery from ammonia purge gases, 5:33364
Gray, T.J., Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy ion bombardment, 5:34258
Green, C., Generation of the industry/occupation wage matrix and related matters. Final report, 5:33671 (DOE/CS/20258—2, pp 86p, Paper 1)
Green, D.C., *See* Penner, S., 5:34083
Green, T.J., *See* Porch, W.M., 5:34133
Greenberg, O.W., Link-operator formulation of quark confinement without van der Waals forces, 5:34285
Greene, S.J., *See* Burleson, G.R., 5:34318
See Ransome, R.D., 5:34095
Greenwood, L.R., *See* Jones, R.H., 5:33895
Greiner, W., *See* Stoecker, H., 5:34358
Grey, D.A., *See* McCarron, R.L., 5:34063
Gridley, K., *See* Seastedt, T.R., 5:34144
Grieve, W., *See* Zivi, S.M., 5:33593
Griffith, R.A., *See* Gardner, J.R., 5:33184
Grimes, J.G., *See* Butz, T.R., 5:33304
Grimes, S.M., Measurements of ^{88}Sr(p,n) to the ground state and low-lying excited states of ^{88}Y, 5:34329 (UCID—18577, pp 3-4)
See Haight, R.C., 5:34335
Grimm, A.V., Semiconductor chip processing. Final report, 5:34052 (BDX—613-2466)
Grimsrud, D.T., *See* Sherman, M.H., 5:33780
Grisham, L.R., *See* Hooper, E.B. Jr, 5:34077
Groncki, P.J., Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)
See Marcuse, W., 5:33368
Gross, D., Vacuum structure and QCD, 5:34303 (LBL—8957, pp 327-353)
Grossbeck, M.L., Tensile properties of type 316 stainless steel irradiated in a simulated fusion reactor environment, 5:33894
Grossman, L., Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
Grosso, S., *See* Pearce, R.L., 5:33281
Grube, L.K., *See* Young, E.G., 5:34448
Gueceri, S.I., *See* Moszynski, J.R., 5:33641
Guenther, P., *See* Smith, A., 5:34337
Guerriero, L., *See* Aitkenhead, W., 5:34296
Guidry, M.W., *See* Rasmussen, J.O., 5:34338
Guin, J.A., *See* Curtis, C.W., 5:33204
See Garg, D., 5:33208
Gula, W.P., One-dimensional computer simulations of exploding pusher targets for the Los Alamos Helios laser system, 5:34421 (LA—8458-MS)
Gulamov, K.G., *See* Azimov, S.A., 5:34363
Gulden, T.D., US/FRG Umbrella Agreement for Cooperation in GCR Development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, April 1, 1980-June 1, 1980, 5:33613 (GA-A—15942)
Gulyamov, U.G., *See* Azimov, S.A., 5:34363
Gunion, J.F., Two-photon collisions and QCD, 5:34288 (SLAC-PUB—2503)
Gunter, B.J., Industrial hygiene surveys of semiconductor plants, 5:34216 (BNL—51118, pp 132-141)
Guralnik, G., *See* Bender, C.M., 5:34389
Gutbrod, H.H., Search for collective phenomena in relativistic nuclear collisions, 5:34360 (LBL—11123)
Guth, E.D., Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas, 5:33356
Guzzardi, R., *See* Bellina, C.R., 5:34191

H

Haas, P.A., *See* Spence, R.D., 5:33307
Hadley, G.R., Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
Hagee, G.R., *See* Yates, W.G., 5:34139
Haggard, K.L., *See* Niles, P.W.B., 5:33483
Hagin, F., Construction of well-conditioned systems for Fredholm I problems by mesh adapting, 5:34453
Hahn, Y., *See* Kai, K., 5:33699
Haight, R.C., Status report to DOE Nuclear Data Committee, 5:34309 (UCID—18577)
Studies of (n, charged particle) reactions with 14 to 15 MeV neutrons, 5:34335 (UCID—18577, pp 5-6)
Haines, B.L., Rainfall element content and acidity from April 30, 1976 to February 17, 1978, Athens, Georgia, 5:34117 (DOE/EV/00641—42)
Haines, H.R., Low temperature specific heats of three plutonium carbides, 5:33905
Hajicek, D., *See* Goblirsch, G., 5:33237
Halama, H.J., ISABELLE vacuum systems, 5:34079 (BNL—27767)

Halbleib, J.A. Sr., Relativistic-electron-beam/target interaction in plasma channels, 5:34430
See Wright, T.P., 5:34429
Halderson, D., Non-statistical effects in neutron reactions on ^{32}S, 5:34324
Hale, G.J., Uniform aluminum deposits on large nonplanar and planar polyimide substrates by physical vapor deposition, 5:33850 (BDX—613-2397)
Hales, J.M., *See* Easter, R.C., 5:34121
Haley, T.J., Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118, pp 189-196)
Hall, R.C., Implementation of logical networks in System 2000 data bases, 5:34460 (SAND—80-1252C)
See Gardner, J.R., 5:33184
Hall, R.O.A., *See* Haines, H.R., 5:33905
Haller, E.E., *See* Joos, B., 5:33880
Hallett, R., *See* Barnhart, B.J., 5:33324
Halpern, Y.S., *See* Samuni, A., 5:34184
Hamilton, C.A., *See* Harris, R.E., 5:34020
Hamilton, J.H., *See* Wells, J.C. Jr., 5:34327
Hamm, R.W., *See* Stokes, R.H., 5:34074
Hammar, R.H., *See* Clague, R.E., 5:33660
Hampton, H.L., *See* Lind, M.A., 5:33538
Hamrick, J.T., *See* Rose, L.C., 5:33250
Hamstad, M.A., Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)
Hanna, W.W., *See* Burton, G.W., 5:34181
Hannett, L.N., *See* de Mello, F.P., 5:33591
Hanson, J.A., *See* Escher, W.J.D., 5:33350, 5:33351
See Foster, R.W., 5:33353
Hanson, R.J., Analysis of measurement based on singular value decomposition, 5:33953 (SAND—80-1482)
Multiple precision integer operation package, 5:34449 (SAND—80-1146)
Hanus, J.B., Stress concentration factors due to flaws near the edge of a plate under tension, 5:33948 (IS-T—928)
Hara, T., Characterization of upgraded coal liquids, 5:33206
Hardekopf, R.A., Operating experience and cesium recycling on the LASL polarized triton source, 5:34076 (LA-UR—80-1905)
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)
See Flynn, E.R., 5:34328
Harmon, B.N., *See* Johnson, D.L., 5:33907
Harrar, J.E., Comparison assay of a gold plating solution by controlled-potential coulometry and fire assay, 5:33923 (UCID—18766)
Harrer, B.J., *See* Nieves, L.A., 5:33592
Harris, H., *See* Englehardt, J., 5:33602
Harris, J.H., *See* Deaver, B.S. Jr., 5:33961
Harris, J.J., Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
Harris, R.E., Fast superconducting instruments, 5:34020
Harris, R.H., Ranking methodology, 5:34197 (BNL—51118, pp 272-278)
Harrison, J.L., Mound Facility explosives incinerator, 5:34102 (MLM—2762(OP))
Hartley, J.N., Asphalt emulsion sealing of uranium mill tailings. 1979 annual report, 5:33317 (PNL—3290)
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
Hartman, J.S., *See* Brenden, B.B., 5:33863
See Lind, M.A., 5:33538
Hasell, D.K., *See* Brown, R.E., 5:34313
Hassberger, J.A., *See* Peterson, R.E., 5:34436
Hastings, J.M., Observation of an unusual magnetic phase transition in $NdSn_3$, 5:33873
Haven, K.F., *See* Ritschard, R.L., 5:33666
Hawrylak, M., Reductions in energy usage at Manitoba Forestry Resources: energy conservation, fuel oil substitution and electrical cost control, 5:33793 (CONF-7905177—1)
Hay, R.D., Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system, 5:33636 (COO—4094-91)
Hayes, J.C., Hydrocarbon conversion with an acidic multimetallic catalytic composite, 5:33259
Hays, R.A., *See* Cobble, M.H., 5:33511
Hayter, S.W., *See* Ramsey, H.D., 5:33928
Haywood, F.F., Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
Hazard, H.R., Influence of coal mineral matter on slagging of utility boilers. Final report, 5:33587 (EPRI-CS—1418)
Healey, D.L., Complete Bouguer gravity map of the Tonopah 1° x 2° quadrangle, Nevada, 5:34224 (USGS-OFR—80-611)
Hebard, A.F., Memory device utilizing the storage of Abrikosov vortices at an array of pinning sites in a superconducting film, 5:34016
Hedstrom, J.C., *See* Balcomb, J.D., 5:33476
Heffner, R.H., Muon spin depolarization in nonmagnetic metals doped with paramagnetic impurities, 5:34253 (LA-UR—80-2375)
See Blazey, K.W., 5:34251
See Schillaci, M.E., 5:34254
See Vanderwater, D.A., 5:34252
Hegerath, A., *See* Nefkens, B.M.K., 5:34315
Heiden, C., *See* Rogalla, H., 5:33975
Heinrich, R.R., *See* Jones, R.H., 5:33895
Heisenberg, J., *See* Papanicolas, C.N., 5:34341
Heiser, J.I., *See* Oxenreider, T.R., 5:33661
Helgerson, R.N., *See* Butz, T.R., 5:33304
Henderson, D.B., Fuel temperature determination for ICF microspheres, 5:34422 (LA—8469-MS)
Hendrey, G.R., Acid precipitation and the aquatic environment, 5:34162 (BNL—28173)
Hendrick, P.L., *See* Simonen, E.P., 5:33900
Hendrickson, R.R., Laboratory and field testing of improved geothermal rock bits, 5:33573 (SAND—80-7102)
Seal/lubricant systems for geothermal drilling equipment, 5:33572 (SAND—80-7101)
Henricks, J.D., Environmental control technology survey of selected US strip mining sites. Volume 2B. Alabama. Water quality impacts and overburden chemistry of Alabama study site, 5:33224 (ANL/EMR—2(Vol.2B))
Henry, *See* Meyer, P., 5:34331
Hensley, D., *See* Maguire, C.F., 5:34326
Hensley, D.C., *See* Wharton, W.R., 5:34323
Herendeen, R.A., Job shifts from energy conservation: salary distriioution effects. Final report, 5:33693 (DOE/CS/20258—2, pp 24p, Paper 2)
Herrell, D.J., High-performance Josephson interferometer latching logic and power supplies, 5:34017
Herskind, B., *See* Deleplanque, M.A., 5:34340
Hessler, R.R., *See* Anderson, D.R., 5:33336
Hewitt, J.D., Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
Hickok, R.L., Ion beam probe diagnostic system. Technical progress report, 1 January 1979-30 June 1980. RPDL report No. 80-17, 5:34397 (DOE/ET/53004—1)
Hickox, C.E., Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste, 5:33334 (SAND—80-0312C)
Steady thermal convection from a concentrated source in a porous medium, 5:34036
Hietarinta, J., *See* Greenberg, O.W., 5:34285
Higgins, E.F., *See* Lawrence, G.P., 5:34086
Hild, N.R., Environmental controls at Motorola, 5:33396 (BNL—51118, pp 76-78)
Hilding, W.E., Basic principles of heat loss and energy consumption in a house. Publication ECR No. 1, 5:33783
Hilfman, L., *See* O'Hara, M.J., 5:33251
Hill, C.T., Penguins and the $\Delta I = 1/2$ rule, 5:34290 (FERMILAB-CONF—80/66-THY)
Hill, J.E., Experimental verification of a standard test procedure for solar collectors, 5:33520 (NBS-BSS—117)
Hillis, D.L., *See* Deleplanque, M.A., 5:34340
Hillstrom, W.A., *See* Johnson, J.A., 5:33437
Hinman, C.W., Hydrocarbon production from arid land plant species, 5:33413
Hinton, F.L., Nonadiabatic effects of field ripple on energetic ions in tokamaks, 5:34401 (DOE/ET/53036—17)
Hipel, K.W., *See* McBean, E.A., 5:34159, 5:34160
Hirayama, A., ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides, 5:34193 (DOE/EV/10343—6)
Hirschfeld, T.B., *See* Pearson, R.K., 5:33432
Hirst, E., Uncertainties in our understanding of energy conservation, 5:33774 (CONF-800835—2)
Hirt, C.W., *See* Amsden, A.A., 5:34443
Hitch, C.J., Resources for an uncertain future, 5:33687
Hites, R.A., *See* Dubay, G.R., 5:33175
Hockenbery, K.A., *See* Ruegg, R.T., 5:33785
Hodges, L., Hodges residence: performance of a direct gain passive solar home in the 1979-1980 heating season, 5:33474 (IS-M—290)
Hodgson, R.T., *See* Yang, E.S., 5:34060
Hoffman, C.M., Monochromatic neutral kaon beam, 5:34067 (LA—8444-MS)
Hoffman, F.O., *See* Schwarz, G., 5:34135
Hoffman, J.M., Phoenix I energy extraction experiment, 5:34032 (SAND—80-0261)
Hoffman, T.J., *See* Fraley, S.K., 5:34044
Hoffmann, J.F., *See* Hinman, C.W., 5:33413
Hofmann, J., *See* Stoecker, H., 5:34358
Hogan, S., Future of photovoltaic energy conversion in developing countries, 5:33446 (SERI/TP—611-407)
Hogenson, P.A., *See* Zimmerman, R.M., 5:33952
Holdeman, L.B., Prototype for a commercial Josephson-effect voltage standard, 5:33980
See Sullivan, D.B., 5:33979
Holdren, J.P., Environmental aspects of renewable energy sources, 5:33680 (UCB/ERG—80-1)
Holian, B.L., Cell-model prediction of the melting of a Lennard-Jones solid, 5:34374
Holl, M.M., The expanded ocean thermal-structure analysis system: a development based on the fields by information blending methodology. Final report, 5:34231 (AD-A—076534)

Hollands, K.G.T., *See* Smart, D.R., 5:34042
Hollas, C.L., *See* Ransome, R.D., 5:34095, 5:34274
See Riley, P.J., 5:34312
Hollebeek, R., SLAC linear collider, 5:34085 (SLAC-PUB—2526)
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)
Hollister, C.D., *See* Anderson, D.R., 5:33336
Hollod, G.J., *See* Shields, J.D., 5:34154
Hollowell, C.D., *See* Berk, J.V., 5:33778
Holly, D.T., *See* Biddle, A.P., 5:34435
Holter, G.M., *See* Murphy, E.S., 5:33318
Holthuis, J.T., *See* Pickus, M.R., 5:34380
Holtkamp, D.B., *See* Burleson, G.R., 5:34318
Holton, W.C., *See* Blocker, T.G., 5:33992
Holzrichter, J.F., High-power pulsed lasers, 5:34427 (UCRL—52868)
Hommert, P.J., Model capabilities for in-situ oil shale recovery, 5:33293 (SAND—80-1873C)
Hooper, E.B. Jr, High current source of He^- ions, 5:34077
Hoover, W.G., *See* Evans, D.J., 5:34267
Hopkins, G.R., *See* Cheng, E.T., 5:34418
Hoppe, R.J., *See* McDonald, R.J., 5:33773
Hornbeck, R.G., *See* Gardner, J.R., 5:33184
Horton, R., *See* Wong, K., 5:34412
Horwitz, E.P., Recovering actinide values, 5:33322
Houck, L.L., *See* Nordman, J.E., 5:34003
Houston, J.E., *See* Madey, T.E., 5:33870
Howard, P.H., *See* Durkin, P.R., 5:34199
Howe. Fission neutron multiplicities for ^{245}Cm, ^{232}Th, and /sup 242m/Am(n,f) reactions, 5:34348 (UCID—18577, pp 12, 13-14)
See White, 5:34347
Howes, J.E. JR., *See* Easter, R.C., 5:34121
Hsie, A.W., Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
Hu, E.L., Josephson tunneling through Ge-Sn barriers, 5:34005
Huang, K., *See* Johnson, W.R., 5:34243
Hubert, H.J., Erection and operation of a Fischer-Tropsch-pilot plant with liquid-phase reactor, 5:33197 (BMFT-FB-T—80-033)
Hudgings, D.W., Injection system for the Proton Storage Ring at LASL. Final report, 5:34078 (LA-UR—80-1945)
See Lawrence, G.P., 5:34086
Hughes, P., *See* Dethlefsen, R., 5:33605
Hughs, R.W., Photoresist dip coating on thin film networks. Final report, 5:33901 (BDX—613-2398)
Hull, W.C., *See* Cobble, M.H., 5:33511
Hunt, L.K., *See* Nelson, J.E., 5:33943
Hunt, P.S., US GCFR demonstration plant design, 5:33618 (GA-A—15932)
Hunter, V.R., Phase change/heat storage materials data compilation. Final technical report, August 1978-January 1979, 5:33640 (AD-A—076414)
Huntress, W.T. Jr., *See* Prasad, S.S., 5:34237
Hurley, F.W., *See* Ewbank, W.B., 5:34310
Hurrell, J.P., SQUID digital electronics, 5:34014
Hurwitz, C.E., Electrooptical devices. Semiannual technical summary report, 1 October 1978-31 March 1979, 5:34030 (AD-A—077153)
Hutchinson, I.H., Observations of fluctuating ω/sub p/ emission in Alcator tokamaks, 5:34411
Hutchison, G.B., Epidemiological considerations, 5:34217 (BNL—51118, pp 226-232)
Hutson, R.L., *See* Schillaci, M.E., 5:34254
Hwa, R.C., Role of valons in low-p/sub T/ physics, 5:34293 (LA-UR—80-2235)
Hyde, J.C., Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)

I

Iannucci, J.J., Value of seasonal storage of solar energy, 5:33543 (DOE/JPL—1060-12(Vol.2), pp 213-247)
Ilan, Y.A., *See* Samuni, A., 5:34184
Ingersoll, J.G., Operating instructions for LBL radon measurement facilities, 5:34137 (LBL—11097)
Ingley, H.A., Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
Irani, C.A., Process for aromatics extraction from a 300 to 430°F boiling range naphtha, 5:33256
Irvine, J.E., Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
Isaacson, A.D., Valence bond diatomics-in-molecules (DIM) treatment of collinear interactions of Group IIa and IIb metal atoms with hydrogen halides: Application to the CaHCl system, 5:34239
Ishii, Y., Investigation on the reliability of expansion joint for piping with probabilistic method, 5:33624 (JAPFNR—506)
See Matsumoto, S., 5:33630
Iwamiya, J.H., *See* Souers, P.C., 5:33346
Izosimov, D.B., Asynchronous drive for an electric automobile under slip conditions, 5:33825 (DOE-tr—230)
Izyurov, V.M., *See* Akimov, Yu. K., 5:34273

J

Jackel, L.D., *See* Hu, E.L., 5:34005
Jackson, D.E., *See* Fox, J.P., 5:33299
Jacobs, K., *See* Shama, A., 5:33390
Jacobson, M.R., New instrumentation for high temperature and hemispherical measurements of selective surfaces, 5:33537
Jacobson, R.A., *See* Powell, D.R., 5:34369
Jacoff, F.S., EPA energy/environmental control technology program. EPA program summary, 5:34118 (EPA—600/8-80-020)
Jaehne, H., St. Paul district-heating study, 5:33808 (CONF-790401—, pp 159-180)
Jaffe, J., *See* Blanton, W.A. Jr., 5:33272
Jaffe, M., Protecting solar access: a guidebook for California communities, 5:33389 (P—500-80-013)
See Erley, D., 5:33472
Jahnle, H.A., *See* Freeman, R.B., 5:33835
Jain, A.K., *See* Sandell, R.D., 5:33998
Jain, M., *See* Porter, R.W., 5:34035
James, D.R., *See* Christophorou, L.G., 5:34238
Janai, M., *See* Booth, D.C., 5:33534
Janocko, M.A., *See* Daniel, M.R., 5:33983
Jantzie, T., Response of confined aquatic biota to mine depressurization water in Beaver Creek Reservoir, 5:34202 (NP—25070)
Jarvinen, P.O., *See* Hay, R.D., 5:33636
Jason, A.J., *See* Hudgings, D.W., 5:34078
See Lawrence, G.P., 5:34086
Jeng, J.F., *See* Curtis, C.W., 5:33204
Jenkins, J.P., *See* Hill, J.E., 5:33520
Jenkins, P.H., *See* Yates, W.G., 5:34139
Jennings, W.C., *See* Hickok, R.L., 5:34397
Jespersen, P., *See* Lindelof, P.E., 5:33997
Jinlai, Z., Geochemistry of China's oilfield water discussed, 5:33271 (JPRS—75887)
Jiyang, W., *See* Siyu, W., 5:33558
Johnson, A.J., Fluidized bed incineration process design for transuranic waste, 5:33320 (RFP—2945)
Johnson, D., Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies, 5:33385 (NP—24996)
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
Johnson, D.L., Self-consistent electronic structure of the refractory metal ZrB_2, a pseudographite intercalation compound, 5:33907
Johnson, D.O., *See* Henricks, J.D., 5:33224
Johnson, D.W., Control and extinguishment of LPG fires. Final report, 5:33270 (DOE/EV/06020—T3)
Johnson, G.R., *See* Reiter, E.R., 5:34113
Johnson, I., Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Johnson, J.A., Process for the simultaneous production of aromatic hydrocarbons and isobutane, 5:33262
Strip selection method of mechanized thinning in northern hardwood pole size stands, 5:33437
Johnson, M.B., Self-consistent theory of hadron-nucleus scattering. Application to pion physics, 5:34354 (LA-UR—80-2496)
Johnson, R.A., *See* Chiang, I-H., 5:34284
Johnson, R.W., *See* O'Hara, M.J., 5:33251, 5:33252
Johnson, W.R., Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
Johnstone, J.K., In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
Jones, A.D., *See* Deno, N.C., 5:33199, 5:33200
Jones, A.H., *See* Hendrickson, R.R., 5:33573
Jones, B.G., *See* Wilson, R.J., 5:33611
Jones, D.E., *See* Hill, J.E., 5:33520
Jones, J.L., Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—, pp II.37.1-II.37.12)
Jones, L.I., Engineering report on the Great Divide Basin drilling project Sweetwater County, Wyoming, May 1980, 5:33301 (GJBX—124(80))
Jones, R.H., Microstructure and tensile properties of T(d,n) and Be (d,n) neutron irradiated nickel, niobium and 316SS, 5:33895
Jones, R.W., Attached sunspace heating performance estimates, 5:33477 (LA-UR—80-2236)
Jones, W.M., *See* Cox, K.E., 5:33355
Jonke, A.A., *See* Johnson, I., 5:33177
Joos, B., Donor complex with tunneling hydrogen in pure germanium, 5:33880

Jordan, R.E., Preliminary study of high-speed machining, 5:33946 (BDX—613-2401)
Josephy, N.H., Hogan's PIES example and Lemke's algorithm. Technical summary report, 5:34441 (AD-A—077103)
Justiniano, E., *See* Gray, T.J., 5:34258

K

Kacinskas, H., *See* Zivi, S.M., 5:33593
Kahn, A., *See* Wallace, N.D., 5:33691
Kahn, J.S., *See* Gnanam, A., 5:33428
Kai, K., Energy self-sufficiency for the County of Kauai. Volume 2. General energy plan, 5:33699 (HNEI—80-04)
Kajitani, S., *See* AdT. R.R. Jr., 5:33848
Kamat, D.P., *See* Baughman, M.L., 5:33735
Kambe, M., *See* Ishii, Y., 5:33624
Kaneda, T., *See* Bates, J.B., 5:34245
Kanhouwa, S.P., Feasibility of financing domestic energy development during 1978-1984. Analysis report AR/EI/79-26, 5:33697 (DOE/EIA—0181/2)
Kanter, I.E., *See* Gass, W.R., 5:33409, 5:33410
Kaper, H.G., Carrier facilitated transport through membranes, 5:33926 (ANL—80-71)
Kaplan, M., *See* Logan, D., 5:34336
Kaplan, S.I., *See* Anderson, T.D., 5:33451
Karam, *See* Waldo, 5:34349
Karichev, Z.R., *See* Lidorenko, N.S., 5:33838
Karlsson, B., Colored stainless steel: a new type of selective absorber, 5:33535
Kasegrande, S.S., *See* Irani, C.A., 5:33256
Kasny, E., *See* Englehardt, J., 5:33602
Katzen, R., *See* Moon, G.D. Jr., 5:33416
Kaufman, L., *See* Williamson, S.J., 5:33969
Kaveshnikov, V.M., Energy aspects of designing electric automobiles and electrical transmissions for them, 5:33824 (DOE-tr—229)
Kazanskii, V.M., Builtin asynchronous electric motor for a light passenger automobile motor-wheel, 5:33828 (DOE-tr—233)
Kearney, R.J., *See* Weber, D.D., 5:33480
Keating, B.A., Alternating energy currents, 5:33668 (CONF-800212—, pp 23-33)
Keech, T.W. Jr., *See* Fasching, G.E., 5:34456
Kendall, H.W., *See* Aitkenhead, W., 5:34296
Kerker, M., *See* Wang, D., 5:34391
Kerr, A.R., *See* Taur, Y., 5:34019
Ketchen, M.B., Present status and future of the dc SQUID, 5:33963
Ketterson, J.B., *See* Abraham, B.M., 5:34101
Kettle, R., *See* Easterling, J., 5:33392
Kevan, S.D., High-resolution angle-resolved-photoemission studies of the MB-point surface state on Cu (001), 5:33876
Normal emission photoelectron diffraction: a new technique for determining surface structure, 5:34099 (LBL—11017)
See Mills, K.A., 5:33877
Khalsa, P.S., Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
Kheifets, S., Electromagnetic fields in an axial symmetric waveguide with variable cross section, 5:34390 (SLAC-PUB—2547)
Recent experimental results on the beam-beam effects in storage rings and an attempt of their interpretation, 5:34075 (SLAC-PUB—2548)
Kieffer, J., SLAC/RAI LSI-11/2 construction/configuration guide, 5:34450 (SLAC-TN—80-2)
Killian, T., *See* Gordon, H., 5:34080
Killpack, T.J., *See* Atwood, J.W., 5:33563
Kim, H.J., *See* Wells, J.C. Jr., 5:34327
Kim, J.H., *See* Pratt, D.C., 5:33434
Kingery, W.D., *See* Berthelet, C., 5:33903
Kingsley, L.M., Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
Kinkade, N.E., Mechanistic study of the hydrogenolysis of neopentane on iridium, 5:33934 (IS-T—909)
Kinsey, C.H., Microcomputer closed circuit television controller, 5:34056 (SAND—79-0688)
Kinsinger, R.E., *See* Benenson, D.M., 5:33600
Kishimoto, Y., *See* Hirayama, A., 5:34193
Kislinger, M.B., *See* Morley, P.D., 5:34353
Kiss, K.D., Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
Kissel, S.E., *See* Hutchinson, I.H., 5:34411
Kissinger, H.E., *See* Brimhall, J.L., 5:33891
Klass, D.L., Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
See Chynoweth, D.P., 5:33427
See Ghosh, S., 5:33357
Klein, D.N., Handbook for photovoltaic cabling, 5:33444 (COO—4094-90)
Klein, M., *See* Herrell, D.J., 5:34017
Klemm, R.A., Demagnetization effects upon the lower critical field of an anisotropic type II superconductor of ellipsoidal shape, 5:34382
Klems, J.H., Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
Klinuga, P., *See* Varma, M.N., 5:34367
Klimowicz, G., Feasibility study for establishing a centralized geothermal data base for New Mexico. Final report, June 1, 1979-October 15, 1979, 5:33547 (NMEI—50)
Klopatek, J.M., *See* Krummel, J.R., 5:34166
Kluge, H., *See* Deleplanque, M.A., 5:34340
Knasel, T.M., System designs fr low cost-low ratio solar concentrators, 5:33528
Knebel, M.E., *See* Ammerlaan, A.C.F., 5:33578
Kneubuehl, F., *See* Affolter, E., 5:34031
Knight, M.J., Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
Knudson, C.L., *See* Farnum, B.W., 5:33205
Koch, C.A., Minerals in the economy of Wyoming, 5:33684
Koch, C.C., Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
Koch, D.A., *See* Farnum, B.W., 5:33205
Koehmstedt, P.L., *See* Hartley, J.N., 5:33317, 5:33319
Kohan, S.M., Production of methanol from wood, 5:33363 (CONF-790520—, pp II.41.1-II.41.12)
Koide, G.T., Open-loop heliostat reflector, 5:33522 (UCID—18764)
Kollmann, H., Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16, 5:33777 (Juel-Spez—64)
Kolstad, C.D., Air quality regulation in spatial equilibrium models, 5:34141 (LA-UR—80-1753)
Koltsova, N.D., *See* Zverev, G.A., 5:33833
Komatsu, M., *See* Walker, P.L. Jr., 5:33194
Konnert, J.H., *See* D'Antonio, P., 5:33924
Konopnicki, M.J., *See* Eberly, J.H., 5:34365
Konzek, G.J., Optimization of costs versus radiation exposures in decommissioning, 5:33627 (PNL-SA—8017)
Koo, J.C., Fusion microsphere targets, 5:33344 (UCRL—83399)
See Andrews, J.E. Jr., 5:33343
Koonin, S.E., *See* Trentalange, S., 5:34362
Koontz, R., National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
Koplow, M.D., Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
Kordesch, K.V., Method of precharging rechargeable metal oxide-hydrogen cells, 5:33644
Kornegay, F.C., *See* Braunstein, H.M., 5:34116
Koss, W., *See* Bergvall, J.A., 5:33365, 5:33366
Koszykowski, M.L., *See* Noid, D.W., 5:34308
Koukounis, C., *See* Bourrel, M., 5:33243
Kowalski, S., *See* de Guerra, E.M., 5:34351
Koyanagi, M., Higher standard voltage generated by multiple Josephson junctions, 5:33981
Kozoyed, L.W., Solar energy design improvement: a methodology for hydronic flat plate collector systems, 5:33512 (AD-A—076836)
Krauthamer, S., Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
Kreider, J.F., First-order design variables for concentrating solar collectors, 5:33527
Kresovich, S., *See* Lipinsky, E.S., 5:33424
Kriese, J.T., *See* Colgate, S.A., 5:34235
Krishnaswamy, S., *See* Gnanam, A., 5:33428
Kriz, J.F., Development of a simulated catalyst aging technique, 5:33264
Kroeger, D.M., *See* Koch, C.C., 5:33906
Kroeger, H., Efimov pathology in effective two-body system, 5:34307 (CONF-800829—5)
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
Few-body scattering integral equation approach, 5:34306 (CONF-800829—4)
Krogness, J.C., *See* Einziger, R.E., 5:33310
Krommes, J.A., Dielectric response in guiding center plasma, 5:34406
Kronenberg, M.W., *See* Erickson, J.J., 5:34173
Krummel, J.R., Simulation approach to a regional resource environment conflict, 5:34166 (CONF-800819—2)
Krusiewski, S.V., *See* Combs, G.F. Jr., 5:33311
Ktorides, C.N., Elaboration of the recently proposed test of Pauli's principle under strong interactions, 5:34295
Kubarych, K.G., Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
Kucera, G.H., *See* Pierce, R.D., 5:33748
Kuhl, D.E., *See* Schelbert, H.R., 5:34175, 5:34176
Kukacka, L.E., *See* Rayfiel, R., 5:33908
Kulcinski, G.L., *See* Lott, R.G., 5:33897
Kunnmann, W., *See* Hastings, J.M., 5:33873
Kuo, T.K., Neutron oscillations and the existence of massive neutral leptons, 5:34297
Kupperman, D.S., *See* Pierce, R.D., 5:33748
Kurtz, S.R., Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)

Kushida, R.O., *See* Lloyd, W.G., 5:33216
Kwan, B., *See* Chiang, I-H., 5:34284
Kwok, L., Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
Kycia, J.H., *See* Court, G.J., 5:34156
Kydes, A.S., Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL), 5:33665 (BNL—51199)

L

Labuntsov, V.A., Self-contained inverters with pulse-width voltage regulation for an ac electric drive in an electric passenger automobile, 5:33831 (DOE-tr—238)
Lackey, M.E., Cold slumping characteristics of a fluidized bed, 5:33239 (ORNL/TM—7377)
Ladd, A.J.C., *See* Evans, D.J., 5:34267
Lai, G.Y., Investigation of several commercial aluminide coatings for carburization protection of a nickel-base alloy, 5:33886 (GA-A—15825)
Laibowitz, R.B., *See* Broers, A.N., 5:33993
Lam, C.S., Possibility of detecting triple gluon coupling and Adler-Bell-Jackiw anomaly in polarized deep inelastic scattering, 5:34294 (SLAC-PUB—2505)
Lam, H., Remarks on the generalized Tukey's lambda family of distributions, 5:34442 (CONF-800820—6)
Lam, N.Q., Effects of radiation-induced segregation and preferential sputtering on the sputtering rate of alloys, 5:33896
Lambert, G., Characterization of the magmatic and fumarolic gases by their radioactive aerosols, 5:34230
Lambert, G.A., *See* Epstein, M., 5:34038
Lamoreaux, R.D., *See* Jacobson, M.R., 5:33537
Lampert, C.M., Microstructural characterization of a black chrome solar selective absorber, 5:33536
LaNauze, R.D., *See* Minchener, A.J., 5:34064
Land, R., Extension and validation of fault-tree analysis for reliability prediction. Final report, 5:33734 (EPRI-AP—1510)
Lande, S.S., *See* Durkin, P.R., 5:34199
Landrum, *See* Howe, 5:34348
See White, 5:34347
Landsberg, H.H., Energy policy: do's and don'ts for the '80s, 5:33695 (CONF-800212—, pp 59-71)
Lanou, R.E. Jr., *See* Aitkenhead, W., 5:34296
Lantz, L.J., Solar index prediction methodology preliminary analysis, 5:33384 (DOE/ET/20090—4)
Lanzl, E.F., Annual report 1978 and final report 1979, 5:34174 (FMI—45)
Lapeyre, G.J., *See* Smith, R.J., 5:33879
Larimore, R.W., Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report, 5:34195 (EPRI-EA—1148(Vol.1))
Larsen, J.W., *See* Livesay, B.R., 5:33885
Larsson, K., *See* Margen, P., 5:33806
Laulainen, N.S., Drift deposition from mechanical draft cooling towers, 5:33589 (PNL-SA—7422)
LaVopa, P., *See* Aitkenhead, W., 5:34296
Lawrence, G.P., LASL high-current proton storage rings, 5:34086 (LA-UR—80-1946)
Lawson, H.P., *See* Johnson, D.W., 5:33270
Le, T.Q., *See* Moskowitz, P.D., 5:33690
Le Dourneuf, M., *See* Johnson, W.R., 5:34243
Le Guern, F., *See* Lambert, G., 5:34230
Leaf, G.K., *See* Kaper, H.G., 5:33926
See Lam, N.Q., 5:33896
Leas, R., Twin Cities institutional issues study: cogenerated hot-water district heating, 5:33807 (CONF-790401—, pp 109-156)
Leavitt, J.A., *See* Dietrich, D.D., 5:34244
Leder, F., *See* Irani, C.A., 5:33256
Lee, J.A., *See* Haines, H.R., 5:33905
Lee, R.N., *See* Easter, R.C., 5:34121
Lee, S.H.D., *See* Johnson, I., 5:33177, 5:33235, 5:33236
Lee, T.D., *See* Christ, N.H., 5:34305
Lee, W.D., *See* Merriam, R.L., 5:33760
Leggett, R.W., *See* Yalcintas, M.G., 5:34185
Leon, M., Models for positive muon depolarization in spin glasses for zero external field, 5:34275 (LA-UR—80-2371)
See Blazey, K.W., 5:34251
See Schillaci, M.E., 5:34254
See Vanderwater, D.A., 5:34252
Leong, H., *See* Reiter, E.R., 5:34113
Lerfald, G., Experimental atmospheric extinction measurements at nine wavelengths between 0.3 and 10 μm, 5:33383
Lesht, B.M., Benthic boundary-layer velocity profiles: Dependence on averaging period, 5:34232
Lessing, P.A., High temperature fuel cell research and development. Final technical status report, 1 March 1979-31 March 1980, 5:33755 (DOE/ET/11320—T1)
Leveille, J.P., *See* Barger, V., 5:34292
Leventhal, J.J., Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
Leversee, G.J., *See* Shields, J.D., 5:34154
Levine, E., *See* Bernow, S.S., 5:33801
Levinsen, M.T., *See* Chiao, R.Y., 5:33989
Lewis, T.T., *See* Brinkworth, B.J., 5:33505
Li, B.A., *See* Lam, C.S., 5:34294
Li, N.C., *See* Hara, T., 5:33206
Lichtenstadt, J., *See* Papanicolas, C.N., 5:34341
Lidorenko, N.S., Hydrogen-air electrochemical energy installation for electric automobiles, 5:33838 (DOE-tr—227)
Methods for perfecting nickel-zinc storage batteries for the power plants of electric automobiles, 5:33826 (DOE-tr—231)
Lieberman, M.L., Deflagration-to-detonation transition project: quarterly report for the period September through November 1979, 5:34103 (SAND—80-1157)
Liegel, B., *See* Brown, S., 5:34148
Lien, *See* Meyer, P., 5:34331
Liepins, G.E., Integrated approach to data editing, 5:34457 (CONF-800820—5)
Light, J.C., *See* Parker, G.A., 5:34383
Lijie, Z., *See* Benshan, W., 5:33242
Lim, H., *See* Bourrel, M., 5:33243
Lind, M.A., Specularity measurements for solar materials, 5:33538
Lindelof, P.E., Superconducting microbridges and arrays, 5:33997
Lipfert, F.W., *See* Hendrey, G.R., 5:34162
Lipinsky, E.S., Fuels from biomass systems for arid land environments, 5:33424 (DOE/TIC—11247)
Lipschultz, B., Axisymmetric instability in a noncircular tokamak, 5:34408 (COO—2387-118)
See Biddle, A.P., 5:34435
Lisowski, P.W., *See* Delheij, P.P.J., 5:34366
Little, W.A., Design and construction of microminiature cryogenic regrigerators, 5:34012
Liu, S.H., *See* Johnson, D.L., 5:33907
Livesay, B.R., Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
Lloyd, J.M., *See* Garg, D., 5:33208
Lloyd, W.G., Model for the isothermal plastometric behavior of coals, 5:33216
Lo, S.Y., *See* Chew, C.K., 5:34287
Lobach, J.L., *See* Nichols, K.E., 5:33569
Lobitz, D.W., VAWTDYN: a numerical package for the dynamic analysis of vertical axis wind turbines, 5:33585 (SAND—80-0085)
Locke, P., Photon Power's sprayed cadmium sulfide/cuprous sulfide photovoltaic solar cells, 5:33398 (BNL—51118, pp 87-90)
Loevhoeiden, G., *See* Straume, O., 5:34334
Logan, D., Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
Lonadier, F.D., *See* Harrison, J.L., 5:34102
Long, W.F., Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, April 1. 1980-June 30, 1980, 5:33608 (DOE/ET/29185—17)
Lorenz, J.J., *See* Yung, D., 5:34266
Lorenzo, C.F., *See* Daniele, C.J., 5:33822
Lott, L.A., *See* Malik, R.K., 5:33851
Lott, R.G., Effect of nickel and nitrogen on void formation in ion bombarded vanadium, 5:33897
Lou, D.Y.S., *See* Moszynski, J.R., 5:33641
Love, S.T., *See* Kuo, T.K., 5:34297
Low, G.B., *See* Chew, C.K., 5:34287
Lowenstein, D.I., Search for narrow structures in the anti pp annihilation cross section from 1925 to 1955 MeV, 5:34270 (BNL—28142)
Lower, W.R., Carcinogenic, mutagenic, and teratogenic effects of cadmium and arsenic, 5:34215 (BNL—51118, pp 197-205)
Loy, E.T., *See* Haywood, F.F., 5:34151
Loy, J.W., *See* Harrar, J.E., 5:33923
Lubliner, J., Stressed mirror polishing. 1: A technique for producing nonaxisymmetric mirrors, 5:34386
See Nelson, J.E., 5:33943
Ludlam, T., *See* Gordon, H., 5:34080
Luebbig, H., Analytic study on the influence of the weak link parameters on the resonant circuit of the nonhysteretic rf SQUID ($W \leqq 10^8$ s^{-1}), 5:33973
Lugo, A.E., *See* Brown, S., 5:34148
Lugol, J.C., *See* Nefkens, B.M.K., 5:34315
Lukens, J.E., Fabrication of microbridge Josephson junctions using electron beam lithography, 5:33994
See Sandell, R.D., 5:33998
Lula, J.W., Cure cycle evaluation for multilayer printed wiring boards, 5:34050 (BDX—613-2392)
Lumsdaine, M., Passive solar house designs for New Mexico climates. Final report, July 1, 1978-January 31, 1980. Part 1: design manual, 5:33482 (NMEI—22)
Lund, M.M., Dow true in situ process for recovery of energy from the Antrim shale, 5:33294
Luthy, R.G., Biological treatment of Grand Forks Energy Technology Center slagging fixed-bed coal gasification process wastewater. Eleventh

quarterly report, March 1979, 5:33220 (FE—2496-42)
Luvishis, A.L., *See* Zverev, G.A., 5:33833
Lyle, W.D., Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
Lynch, D.W., *See* Olson, C.G., 5:33878
Lynn, K.G., Positive muon and the positron as probes of defects, 5:34249 (BNL—28196)
Lyons, D.J., Subsurface geological and geophysical study of the Cerro Prieto geothermal field, 5:33554 (LBL—10540)
Lyons, T., *See* Aitkenhead, W., 5:34296
Lysenko, W.P., Matching bunched beams to alternating gradient focusing systems, 5:34073 (LA—8442-MS)

M

MacCracken, M.C., *See* Mitchell, J.M., 5:34134
Macdonald, R.G., Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932
Machanik, J., *See* DesJardin, R., 5:34021
MacKellar, A.D., *See* Bodmer, A.R., 5:34361
MacLaughlin, D.E., Muon spin rotation and other microscopic probes of spin-glass dynamics, 5:34371 (LA-UR—80-2372)
MacLean, D.I., *See* Graham, T.E., 5:33364
Madey, T.E., Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
Madio, F.R., *See* Vachon, W.A., 5:33586
Maeck, W.J., Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II, 5:33617 (ENICO—1046)
Magerlein, J.H., Current-switched full adder fabricated by photolithographic techniques, 5:34015
Maggi, G., *See* Aitkenhead, W., 5:34296
Magid, L.M., Overview of the national photovoltaic program, 5:33393 (BNL—51118, pp 10-29)
Magiera, E., *See* Hawrylak, M., 5:33793
Maguire, C.F., Comparison of the single-proton pickup reactions ^{40}Ca(^{11}B,^{12}C)^{39}Kand ^{40}Ca(^{13}C,^{14}N)^{39}Kat low and high bombarding energies, 5:34326
See Wells, J.C. Jr., 5:34327
Mahajan, O.P., *See* Walker, P.L. Jr., 5:33194
Mahdi, S.S., Energy substitution in rural domestic sector: use of cattle dung as a source of fuel, 5:33426 (NP—25011)
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)
Maish, A.B., *See* Hendrickson, R.R., 5:33573
Maley, M.P., LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980, 5:34379 (LA—8446-PR)
Malik, R.K., Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
Mameli, L., *See* Seastedt, T.R., 5:34144
Manassen, J., *See* Turner, J.A., 5:33936
Mangaraj, D., *See* Kiss, K.D., 5:33603
Manheimer, W.M., Anomalous transport from plasma waves, 5:34407
Mankin, J.B., *See* Krummel, J.R., 5:34166
Mann, F.M., Neutron environment in d + Li facilities, 5:34082 (HEDL-SA—2123-FP)
Mapoles, E.R., *See* Paik, H.J., 5:33978
Maraman, W.J., General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980, 5:33349 (LA—8454-PR)
March, F., *See* Vachon, W.A., 5:33586
Marcus, W.B., Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
Marcuse, W., Macroeconomic effects of accelerated implementation of renewable energy technologies in the US, 5:33368 (BNL—51092)
Maresch, O., Bridge cutout, 5:33958 (SAND—80-6016)
Bridge cutout, in particular for incandescent lamps to be connected in series, 5:33959 (SAND—80-6017)
Margen, P., Feasibility of a large-scale cogeneration/hot-water district-heating system in the Twin Cities, 5:33806 (CONF-790401—, pp 45-106)
Marklund, J.E., *See* Margen, P., 5:33806
Marks, S., Continuing study of mortality in Hanford workers, 5:34187 (PNL-SA—8106)
Marrus, R., *See* Dietrich, D.D., 5:34244
Martin, J.A., *See* Dressel, W.M., 5:33683
Martin, N., *See* Klimowicz, G., 5:33547
Martin, P., A feasibility study of windpower for the New England area. Final technical report, 4 June-31 October 1979, 5:33583 (AD-A—076614)
Martinez, E., *See* Barnhart, B.J., 5:33324
Martinsen, W.E., *See* Johnson, D.W., 5:33270
Maruhn, J.A., *See* Stoecker, H., 5:34358
Maschoff, L.W., *See* Kinsey, C.H., 5:34056
Masnari, N.A., *See* Solomon, D.E., 5:33345
Mason, G.W., *See* Horwitz, E.P., 5:33322
Massimo, J.T., *See* Aitkenhead, W., 5:34296
Mast, T.S., *See* Nelson, J.E., 5:33943
Masterson, K.D., Optics applied to solar energy IV. Volume 161, 5:33526
Mathey, R.G., *See* Rossiter, W.J. Jr., 5:33781
Matkowsky, B.J., *See* Kaper, H.G., 5:33926
Matsumoto, S., Bellows for control rod drive mechanism of MONJU, 5:33630 (JAPFNR—508)
Matsuyanagi, K., *See* Neergard, K., 5:34330
Mattauch, R.J., *See* Barr, D.W., 5:34001
See Galfo, C.H., 5:34002
Max, C.E., Model for laser driven ablative implosions, 5:34431
Maxey, M.N., Our energy horizons: a missing perspective, 5:33676
Maxfield, D.A., *See* Gardner, J.R., 5:33184
Maxfield, D.P., *See* Askew, W.S., 5:33849
Maxwell, C., *See* Martin, P., 5:33583
Maya, I., *See* Cheng, E.T., 5:34418
Maziasz, P.J., Tensile properties of high oxide SAP containing helium and tritium, 5:33898
See Grossbeck, M.L., 5:33894
McAnulty, D.R., *See* Bernow, S.S., 5:33801
McBean, E.A., Inputs for risk analysis in water systems, 5:34159
Reliability in water resources management, 5:34160
McCarron, R.L., Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
McCarthy, J.S., *See* Papanicolas, C.N., 5:34341
McColl, M., *See* Silver, A.H., 5:34004
McCollister, H., Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
McConathy, R.K., *See* McLaughlin, S.B., 5:34179
McConnaughey, J.S., *See* Ruegg, R.T., 5:33785
McConnell, J.W., *See* Dickens, J.K., 5:34344
McCorkle, K., *See* O'Keefe, D., 5:33354
McCormack, M.C., Hardware/software strategies for fuel economy optimization with exhaust emission constraints in methanol fueled automobiles, 5:33847 (CONF-790520—, pp III.54.1-III.54.15)
McCormick, C., Energy policy study. Volume 12. Governmental actions affecting the environment and their effects on energy markets, 5:34140 (DOE/EIA—0201/12)
McCormick, J., Silicon processes, 5:33397 (BNL—51118, pp 82-86)
McCormick, R.D., Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
McCright, R.D., Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
McDonald, R.J., Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978, 5:33773 (BNL—51171)
McDonald, T., Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
McElroy, D., *See* Haines, H.R., 5:33905
McFadden, K.M., Chemistry of technetium in the environment, 5:33930 (PNL—2579)
McFarland, B.L., *See* Zivi, S.M., 5:33593
McFarland, C.R., Directory of Washington mining operations, 1979, 5:33682
McFarland, R.D., *See* Jones, R.W., 5:33477
McGee, T.D., *See* Bray, D.J., 5:33904
McGinnis, M.R., *See* Ewbank, W.B., 5:34310
McGuire, E.J., Scaled proton ionization cross sections in the Born approximation, 5:34259
McHale, E.T., Chemistry of combustion of fuel-water mixtures. Final technical report, 5:33941 (AD-A—076958)
McHugh, D.J., *See* Irani, C.A., 5:33256
McKee, C.F., *See* Max, C.E., 5:34431
McKinney, W.A., Minerals in the economy of Utah, 5:33685
McLaughlin, S.B., Seasonal changes in within-canopy allocation of ^{14}C-photosynthate by white oak, 5:34179
McLaughlin, S.P., *See* Hinman, C.W., 5:33413
McLemore, D.R., *See* Carlson, M.C.J., 5:33619
McLucas, G.B., *See* McFarland, C.R., 5:33682
McNair, J.M., *See* Carter, W.L., 5:33314
McNamara, T.M., *See* Askew, W.S., 5:33849
McNaughton, M.W., *See* Ransome, R.D., 5:34095
McNeil, J., *See* SethuRaman, S., 5:34110
McNurney, J.M., *See* Larimore, R.W., 5:34195
McVeigh, J.C., Stationary concentrator for industry, 5:33525
McVey, D.F., *See* Hadley, G.R., 5:33335
See Hickox, C.E., 5:33334
McWhirter, D.A., *See* Strandberg, G.W., 5:33315
Mead, W.C., *See* Max, C.E., 5:34431
Meakin, J.D., Cadmium sulfide, 5:33394 (BNL—51118, pp 44-50)

Mehanian, C., *See* Selove, W., 5:34094
Meiron, D.I., *See* Baker, G.R., 5:34265
Melton, W.C., Thermal storage requirements criteria for solar power plants interfacing with utility systems, 5:33449 (DOE/JPL—1060-12(Vol.2), pp 113-121)
Menchaca-Rocha, A., *See* Ortiz, M.E., 5:34322
Mendenhall, B.R., *See* Holl, M.M., 5:34231
Mercer, F.T., Swept narrow band random on random, 5:33954 (SAND—80-1534)
Merriam, R.L., Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
Messick, J.R., *See* Moon, G.D. Jr., 5:33416
Messina, M.G., Biomass, energy, and nutrient estimation of mixed southern hardwoods, 5:33435
Metz, D.J., Chemical Sciences Division, 5:33922 (BNL—50973, pp 7-46)
Meunier, R., *See* Aitkenhead, W., 5:34296
Meyer, F.G., *See* Johnson, A.J., 5:33320
Meyer, P., Determination of properties of short-lived fission products, 5:34331 (UCID—18577, pp 17-18)
See Waldo, 5:34349
Michael, P., *See* SethuRaman, S., 5:34110
Michlmayr, M.J., Sorbent regeneration in a process for removing sulfur-containing impurities from mineral oils, 5:33257
Middleton, J.W., Cross-spectral study of the spatial relationships in the North Pacific sea-surface temperature anomaly field. Report No. 23, 5:34157 (COO—1340-68(Draft))
Mikenberg, G., *See* Aitkenhead, W., 5:34296
Miknis, F.P., Current methods of oil shale analysis and new developments (NMR), 5:33297
Miley, G.H., *See* Moses, R.W. Jr., 5:34415
Milici, R.C., *See* Roen, J.B., 5:33288
Millea, M.F., *See* Silver, A.H., 5:34004
Millener, D.J., Selection rule for E1 transitions, 5:34352
Miller, D.F., *See* Easter, R.C., 5:34121
Miller, D.N. Jr., *See* Koch, C.A., 5:33684
Miller, F.C., Sulfur electrode for sodium-sulfur batteries, 5:33659
Miller, H.H., Evaluation of oxidation techniques for preparing bioassay and environmental samples for liquid scintillation counting, 5:34153 (UCRL—52966)
Miller, J.C., Resonantly enhanced multiphoton ionization and third-harmonic generation in xenon gas, 5:33921
See Cooper, C.D., 5:34246
Miller, J.F., *See* Westlake, D.G., 5:33882
Miller, J.J., *See* Baumel, C.P., 5:33234
Miller, R.E., Thermal decomposition of aromatic substances, 5:33212
Miller, R.L., Tracking of smokestack and cooling tower plumes using wind measurements at different levels, 5:34128 (ORNL/TM—7417)
See Suciu, D.F., 5:33570
Miller, R.W., *See* Antrim, W.D. Jr., 5:33530, 5:33531
Millner, A.R., *See* Hay, R.D., 5:33636
Mills, B.E., Sensitivity experiments: a one-shot experimental design and the ASENT computer program, 5:34104 (SAND—80-8216)
Mills, K.A., Angle-resolved photoemission determination of Λ-line valence bands in Pt and Au using synchrotron radiation, 5:33877
Milora, S.L., Results of hydrogen pellet injection into ISX-B, 5:34417 (ORNL/TM—7422)
Minard, R., *See* Deno, N.C., 5:33199
Minchener, A.J., Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)
Mingtao, Z., *See* Siyu, W., 5:33558
Mintzer, I., *See* Holdren, J.P., 5:33680
Misra, R.V., *See* Mahdi, S.S., 5:33426, 5:33791
Mitchell, J.M., Climate effects workshop, 5:34134 (UCRL—84677)
Miyaguchi, K., UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly, 5:33623 (JAPFNR—503)
Miyano, K., *See* Abraham, B.M., 5:34101
See Tarczon, J.C., 5:33917
Miyata, E.S., *See* Johnson, J.A., 5:33437
Moeller, A.D., Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
Momdzhyan, A.A., Selection of power ratios in the electrical equipment of an electric automobile with combination-type power plant, 5:33837 (DOE-tr—236)
See Dilanyan, E.M., 5:33832
Mones, E.T., *See* Morgan, R.J., 5:33909
Moon, G.D. Jr., Technical and economic assessment motor fuel alcohol from grain and other biomass, 5:33416 (CONF-790520—, pp II.39.1-II.39.11)
Moore, C.B., *See* Macdonald, R.G., 5:33932
Moore, C.F., *See* Burleson, G.R., 5:34318
Moore, D.F., *See* Wolf, E.L., 5:33872
Moore, I.B., *See* Burleson, G.R., 5:34318
Moore, J.E., *See* Wray, W.O., 5:33478
Moreno, J.B., *See* Hoffman, J.M., 5:34032
Morgan, C., *See* Garrison, J.D., 5:33532
Morgan, G.L., *See* Delheij, P.P.J., 5:34366
Morgan, R.J., Failure modes and durability of Kevlar/epoxy composites, 5:33909 (UCRL—83875)
Morin, R., *See* Hadley, G.R., 5:33335
Morley, P.D., Asymptotic freedom and dense baryonic matter, 5:34353
Morozov, V.P., *See* Lidorenko, N.S., 5:33838
Morris, C.L., *See* Burleson, G.R., 5:34318
See Ransome, R.D., 5:34095
Morris, G., *See* Holdren, J.P., 5:33680
Morris, J.F., Optimal thermionic energy conversion with established electrodes for high-temperature topping and process heating, 5:33747 (DOE/NASA/1062—6)
Morris, M.E., Admittance of an infinitely long monopole antenna driven by a coaxial line, 5:34055 (SAND—78-1065)
Admittance of an infinitely long monopole antenna immersed in a dissipative medium and driven by a coaxial line with a nondissipative dielectric bead in the end, 5:34057 (SAND—79-1490)
Morris, W.S., Development of an experimental test apparatus for natural convection solar collectors, 5:33519 (LA-UR—80-2329)
Morse, O., *See* Verderber, R., 5:33767
Mortimer, M.J., *See* Haines, H.R., 5:33905
Moses, C.A., Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—, pp III.51.1-III.51.11)
Moses, R.W. Jr., Stable heating and burn simulations of a reversed-field pinch reactor, 5:34415 (LA-UR—80-2500)
Mosher, D., *See* Ottinger, P.F., 5:34424
Mosier, J.E., Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
Moskowitz, P.D., Ranking energy-conservation measures to establish research priorities: synopsis of a workshop, 5:33690 (BNL—51046)
Moss, J.M., Polarization transfer in inelastic scattering, 5:34319 (LA-UR—80-2427)
Moszynski, J.R., Development of intermediate temperature thermal storage systems. Final technical report, April 1, 1978-May 31, 1979, 5:33641 (DOE/CS/35760—T1)
Moteff, J.D., *See* Zielinski, R.E., 5:33289
Muchnik, G.F., *See* Lidorenko, N.S., 5:33838
Muckerman, J.T., *See* Isaacson, A.D., 5:34239
Mueller, P.K., Development of a particulate sulfate analyzer. Final report, 5:34120 (EPRI-EA—1492)
Mukai, K., *See* Takahashi, T., 5:33622
See Tanigawa, S., 5:33625
Mukherjee, A.K., *See* Arieli, A., 5:33865
Muller, T., Further development of a low-cost solar panel. Final report, September 28, 1979-May 31, 1980, 5:33513 (ALO—2032-2)
Munkelwitz, H.R., *See* Tang, I.N., 5:34161
Murdick, D.A., Energy from the in situ processing Antrim shale: process equipment used in the extraction trials, 5:33291 (FE—2346-74)
Murdoch, B.T., *See* Brown, R.E., 5:34313
Murphy, B.D., Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—, pp 205-218)
Murphy, E.S., Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
Murphy, M.J., *See* Tuft, D.B., 5:33957
Murray, R.C., Dynamic behavior of LLNL buildings during aftershocks of the January 24, 1980 Greenville earthquake, 5:34222 (UCRL—52969)
Murtha, M.J., Power plant fly ash as a resource for alumina and cement, 5:33222 (IS-M—289)
See Burnet, G., 5:33221
Murthy, B.S., *See* Samaga, B.S., 5:33843
Muter, R.B., *See* Slonaker, J.F., 5:33219
Mygind, J., *See* Soerensen, O.H., 5:33988
Myung, H.C., *See* Ktorides, C.N., 5:34295

N

Nabholz, J.V., *See* Haines, B.L., 5:34117
Nagamatsu, H.T., *See* Benenson, D.M., 5:33600
Nakamura, A., *See* Koyanagi, M., 5:33981
Nakamura, S.L., Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
Nalcioglu, O., *See* Yalcintas, M.G., 5:34185
Nangle, J.J., Energy and labor implication of improving thermal integrity of new houses. Final report, 5:33692 (DOE/CS/20258—2, pp 44p, Paper 3)
Narasimhan, T.N., Physical aspects of the interface between the saturated and the unsaturated regimes, 5:34220 (LBL—11178)
Nash, D.B, Brief description of research papers accepted for publication during 1979. Annual report, 5:34183 (UR—3490-1878)
Nash, W.P., *See* Crecraft, H.R., 5:33553
Ne'eman, Y., *See* Sudarshan, E.C.G., 5:34300
Nebel, R.A., *See* Moses, R.W. Jr., 5:34415
Neergard, K., Yrast spectra of ^{146}Gd, ^{147}Gd and ^{152}Dy in the deformed independent particle model, 5:34330 (ANL/PHY—79-4, pp 565-569)

Nefkens, B.M.K., Measurement of $p+d \rightarrow {}^3He+\gamma$ and comparison with the inverse reaction, 5:34315
Neiman, M., *See* Deleplanque, M.A., 5:34340
Nelson, B., *See* Aitkenhead, W., 5:34296
Nelson, J.E., Stressed mirror polishing. 2: Fabrication of an off-axis section of a paraboloid, 5:33943
See Lubliner, J., 5:34386
Nelson, W.R., Meeting the reactor operator's information needs using functional analysis, 5:33629 (CONF-801107—6)
Netzel, D.A., High resolution NMR spectroscopy: its application to shale oil component/type analysis, 5:33298
Netzel, T.L., Picosecond electron transfer in diporphyrin models of Photosystem II of green plants, 5:34167 (BNL—28030)
Neuendorffer, J.W., *See* Ashworth, J.H., 5:33744
Newsom, C.R., *See* Riley, P.J., 5:34312
Newton, G.J., Low Btu gasifier emissions toxicology program. Status report October 1979, 5:34198 (LMF—75)
Ngan, D.Y., *See* Weimer, R.F., 5:33211
Nichols, K.E., Test results from the 500 kW direct contact pilot plant at East Mesa, 5:33569 (LBL—11107)
Nickols, F.A., Numerical methods for analyzing sintering by surface diffusion, 5:33913
Nidola, A., *See* Spaziante, P.M., 5:33651
Nieves, L.A., Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
Niles, P.W.B., Passive solar handbook, 5:33483 (NP—24992)
Nisenoff, M., Use of SQUIDs in low-frequency communication systems, 5:33970
Noeske, H.O., *See* Benenson, D.M., 5:33600
Noid, D.W., Scattering in the quasiperiodic and stochastic regimes, 5:34308 (CONF-800829—7)
Nolan, C.E. Jr., Methods and apparatus for anchoring offshore pipeline, 5:34026
Nolfi, F.V., *See* Agarwal, S.C., 5:33890
Nollet, A.R., Causes and alleviation of explosions in solid waste shredders, 5:34061
See Sherwin, E.T., 5:33815
Nordman, J.E., Excess current in Nb and Nb_3Ga Josephson junctions, 5:34003
Norman, J., *See* O'Keefe, D., 5:33354
Norris, M.J., *See* Hanson, R.J., 5:33953
North, G.G., Differentially-charged and sequentially-switched square-wave pulse forming network, 5:34054
Noton, L.R., *See* Jantzie, T., 5:34202
Nowak, E.J., Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
Nozik, A.J., *See* Turner, J.A., 5:33936
Nunn, C., *See* Bourrel, M., 5:33243
Nuttall, H.E., *See* Hickox, C.E., 5:33334
Nygren, R.E., Irradiation creep studies of titanium alloys, 5:33899
Nyman, H., European district-heating experience with focus on Uppsala hot-water district-heating system, 5:33804 (CONF-790401—, pp 13-32)

O

O'Banion, K., Public reaction to imposed risk, 5:33681 (UCRL—84839)
O'Gara, J.C., University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—, pp 257-265)
O'Hagan, J.B., *See* Walko, R.J., 5:34084
O'Hara, M.J., Hydrocracking with catalyst modified by group IIA, 5:33251
Selective hydrocracking process for middle distillate, 5:33252
O'Keefe, B.J., Politics of energy, 5:33670 (CONF-800212—, pp 45-52)
O'Keefe, D., Preliminary results from bench-scale testing of a sulfur-iodine thermochemical water-splitting cycle, 5:33354 (GA-A—15935)
O'Neill, R.V., *See* Krummel, J.R., 5:34166
O'Sullivan, T.D., Fabrication of alkaline batteries, 5:33654
Obermyer, R., *See* Rao, V.U.S., 5:33191
Ogawa, T., *See* Matsumoto, S., 5:33630
Ogren, D.J., Big Muddy Field low tension flood demonstration project. Second annual report, April 1979-March 1980, 5:33246 (DOE/SF/01424—26)
Oguz, S., Reversible changes in the oscillator strengths of Si-H vibrations in a-Si:H induced by He^+-ion bombardment, 5:33920
Ohlsen, G.G., *See* Hardekopf, R.A., 5:34325
Ohyabu, N., *See* Ali Mahdavi, M., 5:34399
Okubo, S., Does the equation of motion determine commutation relations?, 5:34304
Olander, R.G., *See* Nichols, K.E., 5:33569
Olive, K.A., *See* Schramm, D.N., 5:34234
Olsen, L.C., Metal-insulator-semiconductor photovoltaic devices, 5:33405 (PNL-SA—7778)
Olsen, R.D., *See* Henricks, J.D., 5:33224
Olson, C.G., Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
Olson, J.K., Effects of coal structure and processing conditions on organic effluents from slagging fixed-bed gasification, 5:33193
Ono, M., Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma, 5:34409
Parametric excitation of ion quasi-mode by the pump near the ion cyclotron frequency, 5:34410
See Wong, K., 5:34412
Orifice, D., *See* Englehardt, J., 5:33602
Orszag, S.A., *See* Baker, G.R., 5:34265
Ortiz, M.E., Nonstatistical effects in the $^{12}C(^{15}N,\alpha)$ reaction, 5:34322
Orzechowski, T.J., *See* Bekefi, G., 5:34242
Osborn, J., *See* Felker, P., 5:34180
Osborne, T.H., *See* Biddle, A.P., 5:34435
Ostbo, J.B., *See* Wool, H., 5:33706
Ostroski, J.W., *See* Campbell, R.B., 5:33403
Ottinger, P.F., Ion beam propagation in a filamented channel, 5:34424 (NRL-MR—4180)
Oudar, J., Nonlinear spectroscopy by multiresonant four-wave mixing, 5:34384
Overbey, J.K., *See* McCormack, M.C., 5:33847
Ownby, G.W., *See* Zehner, D.M., 5:33916
Oxenreider, T.R., Explosion resistant battery cover design, 5:33661

P

Pack, D.J., *See* Liepins, G.E., 5:34457
Pai, R.Y., *See* Christophorou, L.G., 5:34238
Paik, H.J., Superconducting gravity gradiometers, 5:33978
Paisner, M.J., Segment density functions of polymer chains confined by absorbing or reflecting barriers, 5:34263 (DOE/ER/01198—T1)
Palmer, D.W., *See* Veneruso, A.F., 5:33565
Palmer, R.B., Laser driven grating linac, 5:34071 (BNL—28131)
See Gordon, H.A., 5:34093
Pande, C.S., Activation of FeTi for hydrogen absorption: an electron microscopic study, 5:33874
Panos, C.N., *See* Bodmer, A.R., 5:34361
Papanicolas, C.N., Suppression of the transverse scattering amplitude in ^{207}Pb, 5:34341
Park, H.D., Characterization of internal boundary layer capacitors, 5:34368 (DOE/ER/01198—1311)
Parker, G.A., Variable interval variable step method for the solution of linear second order coupled differential equations, 5:34383
Parrott, J.R. Jr., *See* Strandberg, G.W., 5:33315
Parzen, G., Empirical model for controlling beam-beam effects in ISABELLE, 5:34070 (BNL—28033)
Pasupathi, V., *See* Einziger, R.E., 5:33310
Patrick, R.E., *See* Batzer, T.H., 5:34437
Patrinos, A.A.N., *See* Miller, R.L., 5:34128
Patterson, E.L., Pulsed magnetic field distribution near conducting rings, 5:34426 (SAND—80-1546)
See Hoffman, J.M., 5:34032
Patton, R., *See* Englehardt, J., 5:33602
Patton, W.P., *See* Nieves, L.A., 5:33592
Paul, W., *See* Oguz, S., 5:33920
Pauly, E.L., *See* Alt, R.D., 5:33836
Pavlushkov, B.E., Load conditions for a storage battery, three-phase voltage inverter and asynchronous traction motor during acceleration of an automobile at set intensity, 5:33823 (DOE-tr—228)
Payne, D.A., *See* Park, H.D., 5:34368
Payne, M.G., *See* Miller, J.C., 5:33921
Pearce, R.L., Amine gas treating solution analysis: a tool in problem solving, 5:33281
Pearson, R.K., Minimally refined biomass fuels: an economic shortcut, 5:33432 (UCRL—84136)
Peaslee, D.C., *See* Lowenstein, D.I., 5:34270
Pedersen, N.F., *See* Soerensen, O.H., 5:33988
Pederson, R., *See* Erickson, J.J., 5:34173
Pefley, R.K., *See* McCormack, M.C., 5:33847
See Samaga, B.S., 5:33843
Peil, C.A., *See* Lund, M.M., 5:33294
Peker, L.K., Bandcrossing in K unequal 0 bands, 5:34339
Pellegrini, C., *See* Wang, J.M., 5:34068
Pelzel, E., Density measurements at high temperatures. Part XII. Specific volume and expansion of magnesium-zinc alloys in the solid and liquid states, 5:33883 (RFP-Trans—285)
Pendergrass, J.H., *See* Frank, T.G., 5:34423
Peng, J.C., *See* DeVries, R.M., 5:34317
Penneman, R.A., *See* Ramsey, H.D., 5:33928
Penner, P.S., Structure of the electric utility industry, 1990. Final report, 5:33710 (DOE/CS/20258—3)
Penner, S., NBS-LASL racetrack microtron, 5:34083 (LA-UR—80-1856)
Pennline, H.W., *See* Rao, V.U.S., 5:33191
Peoples, T.R., *See* Hinman, C.W., 5:33413
Pepper, J.H., *See* Berk, J.V., 5:33778
Percus, J.K., *See* Percus, O.E., 5:34172
Percus, O.E., Ethical procedures in comparative evaluation of drugs, 5:34172 (COO—3077-163)
Perez-Mendez, V., Advances in diagnostic instrumentation, 5:34177 (LBL—9892)
Perne, R., *See* Kroeger, H., 5:34306, 5:34307, 5:34311

Perry, D.L., Imidazolium tetrachlorodioxouranate(VI), $[C_3N_2H_5^+]_2[UO_2Cl_4]^{2-}$, 5:33938
Perry, J.E., Rock bed behavior and reverse thermosiphon effects, 5:33545 (LA-UR—80-2429)
Persyk, D.E., *See* Costrell, L., 5:34091
Peterman, D.J., Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)
Peters, R.A., SQUID signal strength versus frequency - some surprises, 5:33972
Peterson, C.L., *See* Cox, K.E., 5:33355
Peterson, D.W., *See* Chiao, R.Y., 5:33989
Peterson, R.E., Fusion Materials Irradiation test facility initial target design, 5:34436 (HEDL-SA—2019-FP)
Petschek, A.G., *See* Colgate, S.A., 5:34233, 5:34235
Phelps, M.E., *See* Schelbert, H.R., 5:34176
Phillips, D., *See* Messina, M.G., 5:33435
Phillips, R.J., Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)
Phillips, R.J.N., *See* Barger, V., 5:34292
Phillips, W., *See* Funghnan, B.W., 5:33407
Philo, J., *See* Goree, W., 5:33971
Phua, K.K., *See* Chew, C.K., 5:34287
Phyllips, T.W., Neutron total cross section for tritium, 5:34314 (UCID—18577, pp 1,2)
Pick, M.A., *See* Pande, C.S., 5:33874
Pickus, M.R., A15 multifilamentary superconductors by the infiltration process, 5:34380 (LBL—10761)
Pierce, B., *See* Moskowitz, P.D., 5:33690
Pierce, R.D., Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
Piercey, R.B., *See* Maguire, C.F., 5:34326
See Wells, J.C. Jr., 5:34327
Pihlaja, R.K., *See* Lund, M.M., 5:33294
Pincosy, P.A., *See* Hooper, E.B. Jr, 5:34077
Pitasi, M.J., *See* Antrim, W.D. Jr., 5:33530, 5:33531
Pocalujka, L.P., Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
Poda, G.A., Decontamination and decorporation: the clinical experience, 5:33340 (DPSPU—79-30-19)
Podney, W., Measurements of magnetic gradients from ocean waves, 5:33968
Poeppel, R.B., *See* Pierce, R.D., 5:33748
Polian, G., *See* Lambert, G., 5:34230
Pollack, I., *See* Zivi, S.M., 5:33593
Pollitzer, E.L., *See* Hayes, J.C., 5:33259
Polychronakos, V.A., *See* Aitkenhead, W., 5:34296
Pope, D.H., *See* Tison, D.L., 5:34194
Popp, R.A., Expression of embryonic hemoglobin genes in α-thalassemic and in β-duplication mice, 5:34228 (CONF-7905172—1)
Poppe, C.H., *See* Grimes, S.M., 5:34329
Porch, W.M., Long path optical extinction and meteorology in the San Francisco Bay Area, 5:34133 (UCRL—84339)
Porkolab, M., *See* Ono, M., 5:34409, 5:34410
Porter, R.W., Unit thermal performance of atmospheric spray cooling systems, 5:34035
Posa, F., *See* Aitkenhead, W., 5:34296
Posnanski, M., High temperature collector systems and report on integrated systems for cooling, desalination, and power generation, 5:33523
Post, D.E., *See* Hooper, E.B. Jr, 5:34077
Potter, D.I., *See* Agarwal, S.C., 5:33890
Potter, T., *See* Deno, N.C., 5:33199
Potter, T.C., *See* Deno, N.C., 5:33200
Pouder, R., *See* Bhagat, N., 5:33414
Poukey, J.W., *See* Epstein, B.G., 5:34241
Poulsen, P., *See* Hooper, E.B. Jr, 5:34077
Powell, D.R., FOUR: a general crystallographic Fourier program, 5:34369 (IS—4737)
Powers, C.D., Potential effects of PV-related compounds on food webs, 5:34196 (BNL—51118, pp 116-118)
Prager, S.C., *See* Biddle, A.P., 5:34435
Prasad, S.S., Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds, 5:34237
Pratt, D.C., Cattails as an energy source. Final report, 5:33440
Potential of cattails as an energy source. Final report, 5:33434
Wetland energy crops, 5:33433
Pratt, H.R., *See* Schrauf, T.W., 5:34226
Preuninger, F.N., *See* Bilotta, R.M., 5:34240
Price, R.E., Report of the workshop on rf heating in mirror systems, 5:34394 (DOE/ER—0070)
Price, R.R., *See* Erickson, J.J., 5:34173
Pritz, P.M., *See* Butz, T.R., 5:33304
Prober, D.E., *See* Feuer, M.D., 5:33996
Pruett, J.G., Asbestos in air. A bibliography with abstracts, 1964-1980, 5:34126 (NLM/TIRC—80/2)
Pruskowski, J.J., User/programmer guide for UCMD100 set point manipulation from magnetic tape coordinate data, 5:33571 (SAND—80-1585)
Pullman, B., *See* Bechtold, R., 5:33844
Pyle, R.V., Neutral beam development at the Lawrence Berkeley and Lawrence Livermore Laboratories, 5:34416 (LBL—11141)

Q

Qualheim, B., *See* Steinborn, T.L., 5:33337
Quigg, C., (Quark)onium theory and spectroscopy, 5:34289 (FERMILAB-CONF—80/63-THY)

R

Rabenberg, L., Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
Rachford, F.J., *See* Peters, R.A., 5:33972
Radosevich, L.G., Criteria for selection of the thermal storage system for the 10 MW(e) solar power plant to be built in Barstow, California, 5:33455 (DOE/JPL—1060-12(Vol.2), pp 249-266)
Raghavan, R., Solar industrial retrofit system for the Provident Energy Company refinery. Sections 2-8. Final report, September 28, 1979 to July 15, 1980, 5:33492 (DOE/SF/10606—1/2)
Rai-Choudhury, P., *See* Campbell, R.B., 5:33403
Raithby, G.D., *See* Smart, D.R., 5:34042
Raj, S., Structural characteristics of vitrinites, 5:33218
Rajagopalan, M., *See* Logan, D., 5:34336
Rakitsky, W., *See* Deno, N.C., 5:33199
Rakitsky, W.G., *See* Deno, N.C., 5:33200
Ramavataram, S., *See* Dang, G.D., 5:34364
See Ewbank, W.B., 5:34310
Ramayya, A.V., *See* Maguire, C.F., 5:34326
See Wells, J.C. Jr., 5:34327
Ramsbottom, E., Electric storage batteries, 5:33655
Ramsey, H.D., Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory, 5:33928 (LA-UR—80-2414)
Ramspott, L.D., Status of LLNL granite projects, 5:33338 (UCRL—84613)
Rangarajan, A., *See* Bucciarelli, L.L., 5:33637
Rankin, W.N., Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
Ransome, R.D., Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region, 5:34274 (LA-UR—80-1976)
Polarimeter for protons between 300 and 800 MeV, 5:34095 (LA-UR—80-1943)
Rao, V.U.S., Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191
Raouf, N., *See* Jacobson, M.R., 5:33537
Rasmussen, J.O., Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
See Peker, L.K., 5:34339
Ratcliffe, C.T., *See* Abdel-Baset, M.B., 5:33202
Ratigan, J.L., Simulation of a bench scale experiment with an empirical creep law. Technical report, 5:34227 (ONWI—99)
Rayes, L., *See* Land, R., 5:33734
Rayfiel, R., Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
Raynor, G.S., 1979 breeding bird censuses and summary of 1977-1979 results, 5:34142 (BNL—51161)
Reagan, M.G., *See* Veneruso, A.F., 5:33565
Redfield, D., *See* Funghnan, B.W., 5:33407
Reed, K.A., Inclination dependence of pyranometer sensitivity, 5:33382
Reed, K.J., K- and L-shell vacancy sharing between light projectiles and argon targets, 5:34260
Reich, F.R., *See* Brenden, B.B., 5:33863
Reistad, G.M., Geothermal energy: overview, 5:33549 (ORESU-W—78-001, pp 5-23)
Reiter, E.R., Effects of atmospheric variability on energy utilization and conservation. Progress report, 5:34113 (COO—1340-76)
See Ding, Y.H., 5:34112
Reitz, R.D., Application of an explicit numerical method to a reaction-diffusion system in combustion, 5:33942 (COO—3077-162)
Rensel, W.B., *See* Solomon, D.E., 5:33345
Rentz, R.L., Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand, 5:33846 (CONF-790520—, pp III.52.1-III.52.12)
Resmini, F.G., *See* Bacher, A.D., 5:34316
Reynolds, E.H., *See* Swift, H.E., 5:33260
Rhee, K.t., *See* AdT. R.R. Jr., 5:33848
Ribbing, C.G., *See* Karlsson, B., 5:33535
Richards, P.L., Millimeter wave superconducting devices, 5:33985
Richter, B., From the psi to charm: The experiments of 1975 and 1976, 5:34278
Richter, D., Study of the temperature dependence of the localized vibrations of H and D in niobium, 5:33856
Rickertsen, L.D., Graham, R.F., *See* Claiborne, H.C., 5:33327
Riedel, A.A., *See* Walko, R.J., 5:34084
Rigby, J.R., *See* McFarland, C.R., 5:33682
Riley, P.J., Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector

X and p vector $^9Be \rightarrow$ n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
See Ransome, R.D., 5:34274
Ritchie, R.O., Influences of gaseous environment on low growth-rate fatigue crack propagation in steels. Annual report No. 1, January 1980. Report No. FPL/R/80/1030, 5:33858 (DOE/ER/10389—1)
Ritschard, R.L., Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979, 5:33666 (LBL—11183)
Rivet, M.F., *See* Logan, D., 5:34336
Rizk, F.A.M., *See* Beausejour, Y., 5:33609
Roberts, P.E., *See* Souers, P.C., 5:33346
Roberts, R., Technical planning study: Pressurized Fluidized-Bed Combustion. Final report, 5:33238 (EPRI-CS—1465)
Robinson, F.R., Toxicology of boron and boron-containing materials, 5:34205 (BNL—51118, pp 157-162)
Toxicology of beryllium and beryllium-containing chemicals, 5:34208 (BNL—51118, pp 174-179)
Robinson, G.D., Investigation of the interaction of an SPS rectenna with its environment, 5:34109 (ANL/EES-TM—93)
Robinson, M.G., *See* Solomon, D.E., 5:33345
Robinson, P., Photovoltaic programs at RCA, 5:33399 (BNL—51118, pp 91-93)
Robinson, P.H., *See* D'Aiello, R.V., 5:33406
Robinson, R.L., *See* Ortiz, M.E., 5:34322
See Wells, J.C. Jr., 5:34327
Rodgers, B.R., *See* Hewitt, J.D., 5:33214
Roen, J.B., Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee, 5:33288 (DOE/METC/10866—18)
Rogalla, H., Application of a microwave biased rf-SQUID-system to investigate magnetic after-effects, 5:33975
Rogers, E.A., *See* Minchener, A.J., 5:34064
Rohatgi, A., *See* Campbell, R.B., 5:33403
Rohrs D.T., Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
Rojo, O., *See* Aguilera-Navarro, V.C., 5:34350
Rollo, F.D., *See* Erickson, J.J., 5:34173
Roppo, M.N., *See* Ganic, E.N., 5:34039
Rose, H.A., *See* Bender, C.M., 5:34389
Rose, L.C., Process and system for recovering hydrocarbons from underground formations, 5:33250
Rosei, R., *See* Olson, C.G., 5:33878
Rosen, M., *See* Pickus, M.R., 5:34380
Rosenhoover, W.A., *See* Zielke, C.W., 5:33209
Rosenson, L., *See* Aitkenhead, W., 5:34296
Rossiter, W.J. Jr., Criteria for retrofit materials and products for weatherization of residences, 5:33781 (NBS-TN—982)
Rossnagel, S.M., *See* Staib, P., 5:34398
Rostler, P., *See* Douglas-Hamilton, D.H., 5:34027
Roth, J.A., *See* Roth, L.B., 5:34006
Roth, L.B., Super-Schottky and Josephson-effect devices using niobium on thin silicon membranes, 5:34006
Roulet, C.P., *See* Deleplanque, M.A., 5:34340
Rowell, D., *See* Goldschmied, F.R., 5:33590
Rowell, J.M., *See* Wolf, E.L., 5:33872
Roy, P., Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
Roy, R.P., *See* Wilson, R.J., 5:33611
Ruderman, H., *See* Ritschard, R.L., 5:33666
Ruegg, R.T., Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
Ruppel, H.M., *See* Amsden, A.A., 5:34443
Russell, M.C., Solar photovoltaic systems for residences in the Northeast, 5:33445 (DOE/ET/20279—100)
Russo, A.J., *See* Hickox, C.E., 5:33334
Russo, M., *See* Barone, A., 5:34000
Ruth, R.D., *See* Courant, E.D., 5:34069
Ryther, J.H., Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)

S

Sabatini, R.L., *See* Pande, C.S., 5:33874
Sabroux, J.C., *See* Lambert, G., 5:34230
Sager, R., *See* Podney, W., 5:33968
Sakai, N., Nonperturbative vacuum and hard scattering processes, 5:34301 (FERMILAB-CONF—80/68-THY)
Sakaji, R.H., *See* Fox, J.P., 5:33299
Salesky, W.J., Sliding wear, toughness and microstructural relationships in high strength Fe/Cr/C experimental steels, 5:33854 (LBL—10994)
Salmons, L.A., *See* Beavers, J.A., 5:33515
Samaga, B.S., Evaluation of methanol for reduced exhaust emissions in a single-cylinder research engine, 5:33843 (CONF-790520—, pp II.24.1-II.24.16)
Samson, J.A.R., *See* Woodruff, P.R., 5:34248
Samuni, A., Distinction between the roles of O_2 and of O^-_2 in biological radiodamage, 5:34184 (DOE/EV/03221—68)
San Sebastian, J.R., *See* Hsie, A.W., 5:34200
Sandel, M., *See* Aguilera-Navarro, V.C., 5:34350
Sandell, R.D., Study of the properties of coherent microbridges coupled by external shunts, 5:33998
See Lukens, J.E., 5:33994
Sanderson, C., *See* Costrell, L., 5:34091
Sankur, V.D., *See* Lloyd, W.G., 5:33216
Santilli, R.M., *See* Ktorides, C.N., 5:34295
Santodonato, J., *See* Durkin, P.R., 5:34199
Sapienza, G.R., *See* Calm, J.M., 5:33802
Sargent, C.P., *See* Papanicolas, C.N., 5:34341
Sathaye, J., *See* Ritschard, R.L., 5:33666
Satkiewicz, F.G., *See* Feldman, C., 5:33411
Sauerwald, F., *See* Pelzel, E., 5:33883
Sav, G.T., *See* Ruegg, R.T., 5:33785
Savenich, R.A., *See* Francis, J.M., 5:33620
Sawyer, R.F., Formation and destruction of pollutants in combustion processes: clearing the air on the role of combustion research, 5:34125 (LBL—11237)
Sax, N.I., Toxicology of phosphorus, thiourea, and other chemicals, 5:34211 (BNL—51118, pp 206-217)
Saxena, J., *See* Durkin, P.R., 5:34199
Sayer, R.O., *See* Wells, J.C. Jr., 5:34327
Scala, R.A., Industrial toxicology, 5:34214 (BNL—51118, pp 279-282)
Scamehorn, J., *See* Bourrel, M., 5:33243
Scarbrough, J.O., *See* Koch, C.C., 5:33906
Schaefer, H.G., Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens, 5:33213
Schaich, B.A., Biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978, 5:34158 (ORNL/TM—7127)
Schalles, J., *See* Shields, J.D., 5:34154
Schanz, J.J. Jr., *See* Dunkerley, J., 5:33742
Scharre, D.L., Radiative transitions from the psi (3095) to ordinary hadrons, 5:34276 (SLAC-PUB—2519)
Schechter, R.S., *See* Bourrel, M., 5:33243
Schelbert, H.R., Cardiovascular nuclear medicine 1980, 5:34175 (UCLA—12-1257)
Positron computed tomography: current state, clinical results and future trends, 5:34176 (UCLA—12-1258)
Schillaci, M.E., Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
Schimke, G.R., *See* Vachon, W.A., 5:33586
Schissel, P., *See* Carroll, W.F., 5:33521
Schlatter, E.C., Raridon, R.J., *See* Murphy, B.D., 5:33810
Schleimer, G.E., Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
Schlessinger, L., High-energy bremsstrahlung in an intense laser field, 5:34404
Schmalz, T.G., *See* Parker, G.A., 5:34383
Schmidt, F.A., Efficient solar cells by space processing. Final report, October 1, 1978-December 14, 1979, 5:33404 (IS—4723)
Schmittroth, F., *See* Mann, F.M., 5:34082
Schneider, D., *See* Reed, K.J., 5:34260
Schneider, L.C., *See* Rao, V.U.S., 5:33191
Schnell, R.L., Paraquat and pine trees in east Tennessee, 5:33438
Schnurr, N.M., *See* Wray, W.O., 5:33478
Schobert, H.H., *See* Olson, J.K., 5:33193
Schoeny, R.S., *See* Warshawsky, D., 5:34201
Schramm, D.N., Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957, pp 241-260)
Schrauf, T.W., Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
Schroeder, E., Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory, 5:33673 (LBL—11349)
Schubert, J.P., *See* Henricks, J.D., 5:33224
Schueler, D.G., Systems development activities and photovoltaic concentrator technology, 5:33442 (BNL—51118, pp 51-60)
Schwartz, L., Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
Schwartz, P.M., *See* Roth, L.B., 5:34006
Schwarz, G., Stochastic model of radioiodine transport, 5:34135 (CONF-8004111—1)
Scott, B.C., Gas and aerosol scavenging, 5:34130 (PNL-SA—8170)
Scott, M.J., *See* Webb, R.L., 5:34041
Scott, T.E., *See* Verkade, M.E., 5:33887
Scotti, R., *See* Barr, R., 5:33458
Seaborg, G.T., Search of new elements. Plans and perspectives, 5:34343
Seagrave, J.D., *See* Phyllips, T.W., 5:34314
Seamon, R.E., Graphs of the cross sections in the Alternate Monte Carlo Cross Section library at the Los Alamos Scientific Laboratory, 5:34346 (LA—8394-MS)
Sears, F.M., Analysis of microcracks in dry polycrystalline NaCl by ultrasonic

signal processing, 5:34049 (UCRL—52975)
Seastedt, T.R., Arthropod use of invertebrate carrion, 5:34144 (DOE/EV/00641—34)
Sedgewick, T.O., *See* Yang, E.S., 5:34060
Segler, S.L., *See* Cool, R.L., 5:34272
Seidman, D., Values in conflict: design considerations for a two-stage synfuels development strategy, 5:33708 (RAND/N—1469-DOE)
Sekel, D.J., *See* Luthy, R.G., 5:33220
Seki, A., *See* Kai, K., 5:33699
Selove, W., Are high-p/sub T/ events dominated by non-jet processes, 5:34271 (COO—3071-248)
Some energy resolution effects for hadron jets in a calorimeter array, 5:34094 (COO—3071-245)
Selvaggi, G., *See* Aitkenhead, W., 5:34296
Seman, E.J., *See* Campbell, R.B., 5:33403
Semikov, Yu.I., *See* Kaveshnikov, V.M., 5:33824
Seraphin, B.O., *See* Booth, D.C., 5:33534
See Carver, G.E., 5:33533
See Jacobson, M.R., 5:33537
SethuRaman, S., Atmospheric boundary layer measurements during summer MONEX 79 at Digha, India, 5:34110 (BNL—51149)
Shama, A., Social values and solar energy policy: the policy maker and the advocate, 5:33390 (SERI/RR—722-329R)
Shanks, H.R., Assessment of needs for environmental controls for burning a coal-oil mixture in a slot forge furnace, 5:34123 (IS—4709)
See Schmidt, F.A., 5:33404
Shapira, D., *See* Maguire, C.F., 5:34326
See Ortiz, M.E., 5:34322
Shapiro, S.M., *See* Richter, D., 5:33856
Sharp, D.H., *See* Bender, C.M., 5:34389
Sharp, R., *See* O'Keefe, D., 5:33354
Shaw, B.J., Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement, 5:33859 (DOE/ET/13513—T1)
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 6, November 15, 1979-February 15, 1980, 5:33860 (DOE/ET/13513—T2)
Sheaffer, J.D., *See* Reiter, E.R., 5:34113
Sheer, R.E. Jr., *See* Benenson, D.M., 5:33600
Shen, Y.R., *See* Oudar, J., 5:34384
Shenton, L.R., *See* Lam, H., 5:34442
Shepard, D.A., Sprott, J.C., *See* Biddle, A.P., 5:34435
Sheridan, R.J., Massachusetts study of the retrofit insulation industry, 5:33771
Sherman, M.H., Air infiltration measurement techniques, 5:33780 (LBL—10705)
Sherwin, E.T., New technological developments in processing solid waste to energy, 5:33815
See Nollet, A.R., 5:34061
Shetron, S.G., *See* Johnson, J.A., 5:33437
Shields, G.A., *See* Weisheit, J.C., 5:34236
Shields, J.D., Locations and areas of ponds and Carolina Bays at the Savannah River Plant, 5:34154 (DP—1525)
Shih, S., *See* Deleplanque, M.A., 5:34340
Shimizu, M., Extraction method of tritium, 5:33933
Shimshock, R.P., *See* Jacobson, M.R., 5:33537
Shinohara, K., *See* Hirayama, A., 5:34193
Shinpaugh, W.H., *See* Haywood, F.F., 5:34151
Shirley, D.A., *See* Kevan, S.D., 5:33876
See Mills, K.A., 5:33877
Shoemaker, F.C., Research highlights for the period February 1, 1980-July 31, 1980, 5:34268 (DOE/ER/03072—T2)
Shore, B.W., *See* Eberly, J.H., 5:34365
Short, R., *See* Muller, T., 5:33513
Shoshani, A., *See* Eggers, S.J., 5:34459
Shugart, H.H., Verification, validation, and application of detailed forest succession models, 5:34145 (DOE/TIC—11249)
Shumate, S.E. II, *See* Strandberg, G.W., 5:33315
Sibbett, B., *See* Glenn, W.E., 5:33555
Siddall, R.G., Industrialised plant growing system, 5:33798
Sidhar, R.M., Proposed electric power projects, 5:33737 (P—300-80-001)
Sidles, P.H., Operational experiences from the federal solar heating and cooling demonstrations, 5:33473 (IS-M—286)
Siegelman, H.W., *See* Court, G.J., 5:34156
Sierk, A.J., *See* Trentalange, S., 5:34362
Silver, A.H., Superconductor-semiconductor device research, 5:34004
See Hurrell, J.P., 5:34014
Silverman, B.H., *See* Nefkens, B.M.K., 5:34315
Sim, J.W., *See* Pierce, R.D., 5:33748
Similon, P., *See* Krommes, J.A., 5:34406
Simmons, G.W., *See* Wei, R.P., 5:33188
Simon, R.S., *See* Deleplanque, M.A., 5:34340
Simonen, E.P., Light ion irradiation-induced creep mechanisms in nickel, 5:33900
Simpson, H.D., Cobalt-molybdenum-alumina desulfurization catalyst, 5:33254
Sinclair, W., Circuits for heating storage batteries, 5:33657
Singh, A., Crack depth determination by ultrasonic frequency analysis aided by dynamic photoelasticity, 5:34045 (IS-T—900)
Singh, K.K., *See* Bahadur, S., 5:33425
Singh, R.N., *See* Pierce, R.D., 5:33748
Siyu, W., Present state, future prospects of geothermal exploration reviewed, 5:33558 (JPRS—75887)
Sjoblom, R.K., *See* Ahmad, I., 5:34345
Skocpol, W.J., High-frequency properties of microbridge and point contact Josephson junctions, 5:33999
Skolnik, E.G., *See* McHale, E.T., 5:33941
Skow, L.C., *See* Popp, R.A., 5:34228
Slawson, P.R., Dispersion modeling of a plume in the tar sands area. Syncrude environmental research report, 1980-1981, 5:34127 (NP—25069)
Slichter, C.P., *See* Suits, B.H., 5:33875
Slonaker, J.F., Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979, 5:33219 (DOE/ET/10533—9)
Smallwood, D.O., Improved recursive formula for calculating shock response spectra, 5:33951 (SAND—80-1315C)
Smart, D.R., Free convection heat transfer across rectangular-celled diathermanous honeycombs, 5:34042
Smith, A., Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region, 5:34337
Smith, A.H., *See* Sulek, K., 5:34189
Smith, B.V., *See* Sherman, M.H., 5:33780
Smith, D.H., Raman spectroscopy of molten mixtures of lithium and potassium sulfate, 5:33929 (CONF-800808—6)
Smith, H.V. Jr., *See* Lott, R.G., 5:33897
Smith, J.L., *See* Pierce, R.D., 5:33748
Smith, L., Model study of the regional hydrogeologic regime, Roosevelt Hot Springs, Utah, 5:33552 (DOE/ET/28392—44)
Smith, R.C., Tissue equivalent proportional counter neutron monitor, 5:34088 (HEDL-SA—2041)
Smith, R.J., Further studies of Ni (001)c(2 x 2)CO: Evidence for back donation in the chemisorption bond, 5:33879
Smith, R.P., *See* Erikson, R.L., 5:33635
Smith, S.D., *See* Gordon, H.A., 5:34093
Smyth, J.R., *See* Bray, D.J., 5:33904
Snyder, H.J., *See* Hunt, P.S., 5:33618
Sobek, A.A., *See* Henricks, J.D., 5:33224
Soerensen, O.H., Microwave parametric amplifiers using externally pumped Josephson junctions, 5:33988
Solomon, A., *See* Eklund, N., 5:34388
Solomon, D.E., Process for manufacture of inertial confinement fusion targets and resulting product, 5:33345
Somorjai, G.A., *See* Castner, D.G., 5:33203
Sonder, E., *See* Woosley, J.D., 5:33910
Soran, P.D., *See* Seamon, R.E., 5:34346
Sorenson, J.B., Political side of risk: a new approach, 5:33675 (SAND—80-1871C)
Sorokin, P.P., Study of lasers. Final report, 15 July 1976-14 July 1979, 5:34028 (AD-A—076507)
Sottovia, P., *See* Englehardt, J., 5:33602
Souers, P.C., Dielectric constant and electrical conductivity of liquid D-T, 5:33346
Soulen, R.J. Jr., *See* Sullivan, D.B., 5:33979
Sourkes, A.M., *See* Brown, R.E., 5:34313
Spaepen, F., *See* Bristowe, P.D., 5:33855
Spalaris, C.N., *See* Roy, P., 5:33862
Spalek, G., *See* Lawrence, G.P., 5:34086
Spaziante, P.M., Rechargeable zinc halogen battery, 5:33651
See de Nora, V., 5:33662
Spence, R.D., Preparation of thorium-uranium gel spheres, 5:33307 (CONF-800802—12)
Spencer, R.L., Bifurcation of sharp boundary $\beta = 1$ multipole equilibria, 5:34396
Magnetic islands and stochastic field lines in the RFP, 5:34414 (LA-UR—80-2406)
Spicer, C.W., *See* Easter, R.C., 5:34121
Spinelli, P., *See* Aitkenhead, W., 5:34296
Spivey Fox, M.R., Cadmium toxicity and its relationship to other metals, 5:34209 (BNL—51118, pp 180-188)
Spongberg, R.C., US Government appraisal of the potential of solar energy for industry, 5:33508
Spooner, S., *See* Child, H.R., 5:34090
Spruch, L., *See* Wadehra, J.M., 5:34261
Spurny, W.F., *See* AdT. R.R. Jr., 5:33848
Stachyra, L.J., *See* Epstein, M., 5:34038
Stadter, J., *See* Barr, R., 5:33458
Staib, P., In-situ impurity measurements in PDX Edge plasma, 5:34398 (PPPL—1688)
Stamets, L., *See* Khalsa, P.S., 5:33712
Stamper, K.R., 50,000 mile methanol/gasoline blend fleet study: a progress report, 5:33841 (CONF-790520—, pp I.9.1-I.9.14)
Stang, L., Health effects of photovoltaic technology, 5:33387 (BNL—51118)
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118, pp 141-156)
Stangeland, B.E., *See* Sullivan, R.F., 5:33295
Stanley, M.L., Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
Stanulonis, J.J., *See* Swift, H.E., 5:33260
Stapleton, R.E., *See* Campbell, R.B., 5:33403
Staub, F.W., Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
Stauffer, H.C., *See* Frayer, J.A., 5:33253
Stavinoha, L.L., *See* Eichelberger, J.R., 5:33278
Steele, R.S. Jr., Data analysis techniques used at the Oak Ridge Y-12 Plant Flywheel Evaluation Laboratory, 5:33639 (Y/DX—135)

Steele, W.J., *See* Morgan, R.J., 5:33909
Stein, H.J., *See* Oguz, S., 5:33920
Stein, S.E., *See* Miller, R.E., 5:33212
Stein, S.R., Superconducting resonators: high stability oscillators and applications to fundamental physics and metrology, 5:33982
Steinberg, M., Flash hydropyrolysis of coal. Quarterly report No. 10, July 1-September 30, 1979, 5:33210 (BNL—51172)
Process Sciences Division, 5:33574 (BNL—50973, pp 68-95)
See Fallon, P.T., 5:33196
Steinborn, T.L., Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
Stellrecht, D.E., *See* Einziger, R.E., 5:33310
Stephens, F.S., *See* Deleplanque, M.A., 5:34340
Stephens, M.M., DYMAC digital electronic balance, 5:33342 (LA—8313-M)
Stetkar, R.E., *See* Steinborn, T.L., 5:33337
Stevens, P.N., *See* Fraley, S.K., 5:34044
Stevens, T., *See* Eastman, C., 5:33818
Stevenson, P.M., *See* Barger, V., 5:34292
Sticker, H., *See* Cool, R.L., 5:34272
Stiger, R.R., Moderate temperature geothermal: a direct source of process energy, 5:33577 (CONF-801014—1)
Stockdale, W.G., *See* Murphy, B.D., 5:33810
Stoecker, H., Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions, 5:34358 (LBL—8957, pp 355-417)
Stoffel, K.L., *See* McFarland, C.R., 5:33682
Stokes, R.H., Radio-frequency quadrupole: general properties and specific applications, 5:34074 (LA-UR—80-1855)
Stolterfoht, N., *See* Reed, K.J., 5:34260
Stottlemyre, J.A., *See* Erikson, R.L., 5:33635
Stowe, C.H., *See* McKinney, W.A., 5:33685
Strait, E.J., Divertor experiments in a toroidal plasma, with E x B drift due to an applied radial electric field, 5:34433 (COO—2387-117)
Poloidal divertor experiment with applied E vector x B vector/B^2 drift, 5:34434 (DOE/ET/53051—5)
Strandberg, G.W., Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
Strange, J.R., *See* Durkin, P.R., 5:34199
Straume, O., Single-proton states in ^{149}Pm, 5:34334
Straume, T., Response of a fast neutron criticality monitor to prompt critical bursts, 5:34092
Streeter, R.C., Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980, 5:33183 (DOE/ET/14815—12)
Streich, S.G., Retrievable plug for offshore platforms, 5:34025
Strode, J.N., *See* Smith, R.C., 5:34088
Strong, R.D., Generalized ultrasonic system for microcomputer controlled data collection, 5:34047 (LA-UR—80-2040)
Struble, G.L., *See* Haight, R.C., 5:34309
Struck, R.T., *See* Zielke, C.W., 5:33209
Styris, D.L., *See* Jones, R.H., 5:33895
Su, W., *See* Castle, J., 5:33504
Suciu, D.F., Removal of silica from Raft River geothermal water, 5:33570 (EGG-FM—5170)
Sudar, S., *See* Zivi, S.M., 5:33593
Sudarshan, E.C.G., Progress report on research program in elementary particle theory, 1979-1980, 5:34300 (DOE/ER/03992—392)
Suenaga, M., Metallurgy and Materials Science Division, 5:34376 (BNL—50973, pp 47-68)
Sugalski, R.K., Battery charger with liquid crystal charge current indicator, 5:33656
Suits, B.H., Confirmation of McMillan's concept of "discommensurations", 5:33875
Sulek, K., Effect of microwaves on the immune system. Technical report, 5:34189 (AD-A—076768)
Sullivan, D., *See* White, D.H., 5:34392
Sullivan, D.B., Future of superconducting instruments in metrology, 5:33979
Sullivan, R.F., Raw shale oil upgrading, 5:33295
Sullivan, W.N., *See* Lobitz, D.W., 5:33585
Sundberg, R.E., Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—, pp 221-243)
Sunier, J.W., *See* Flynn, E.R., 5:34328
See Straume, O., 5:34334
Suranyi, P., Inelastic strong interactions at high energies. Annual progress report, June 1, 1978-May 31, 1979, 5:34299 (COO—2978-4)
Suresh, S., *See* Ritchie, R.O., 5:33858
Suter, G.W. II, Terrestrial perturbation experiments as an environmental assessment tool, 5:33679 (ORNL/TM—7186)
Suyama, Y., Comprehensive progress report, 1977-1980, 5:34168 (DOE/EV/03083—T1)
Suzuki, F., *See* Matsumoto, S., 5:33630
Svedberg, R.C., Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace, 5:33852 (HEDL-SA—2189)
Sverdrup, G.M., *See* Easter, R.C., 5:34121
Swartz, B., Compact, implicit difference schemes for a differential equation's side conditions, 5:34455
See de Boor, C., 5:34454
Sweeney, W.M., Low pour point crude oil compositions, 5:33275
Low pour residual fuel compositions, 5:33277
Residual fuel compositions with low pour points, 5:33276
Sweny, J.W., High CO_2-high H_2S removal with SELEXOL solvent, 5:33282
Swift, H.E., Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix, 5:33260
Swift, W.M., *See* Johnson, I., 5:33177, 5:33235, 5:33236
Switendick, A.C., Electronic structure of nonstoichiometric cubic hydrides, 5:34372 (SAND—79-1540C)
Szego, G.C., Analysis of the economic potential of solar thermal energy to provide industrial process heat in the United States, 5:33507

T

T'ien, J.S., Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)
Taboas, A.L., US Department of Energy acceptance of commercial transuranic waste, 5:33328 (RFP—3110)
Tahiliani, V., *See* Dethlefsen, R., 5:33605
Takahashi, T., Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
See Tanigawa, S., 5:33625
Talbert, D.M., *See* Anderson, D.R., 5:33336
Tallon, J.T., *See* Luthy, R.G., 5:33220
Tan, C., Regge slopes in dual topological expansion, 5:34286
Tan, E.L., *See* Hsie, A.W., 5:34200
Tang, I.N., Sulfuric acid spills in marine accidents, 5:34161 (BNL—28123)
Tanigawa, S., Development of bellows for sodium valve in Japan, 5:33625 (JAPFNR—507)
Tarasyan, A.P., *See* Varpetyan, V.S., 5:33829
Tarczon, J.C., Surface-induced ordering of a liquid crystal in the isotropic phase. II. 4-methoxybenzylidene-4'-n-butylaniline (MBBA), 5:33917
Tardiff, G.E., *See* McCright, R.D., 5:33575
Tarrer, A.R., *See* Curtis, C.W., 5:33204
See Garg, D., 5:33208
Tarter, C.B., *See* Weisheit, J.C., 5:34236
Taur, Y., Progress on millimeter wave Josephson junction mixers, 5:34019
Taylor, A., *See* Agarwal, S.C., 5:33890
Taylor, F.E., Proposal for a new neutrino detector at Fermilab to study the weak neutral current. Annual technical progress report, 5:34061 (DOE/ER/05023—1)
Teegarden, K.J., Development of ferromagnetic spinels for optical isolation at 10.6 μm, 5:33912 (DOE/DP/40050—9)
Ternan, M., *See* Kriz, J.F., 5:33264
Terrien, Y., *See* Nefkens, B.M.K., 5:34315
Tewari, K.C., *See* Hara, T., 5:33206
Thacker, H.B., Exact integrability in quantum field theory, 5:34302 (FERMILAB-CONF—80/69)
Thiessen, H.A., *See* Burleson, G.R., 5:34318
See Ransome, R.D., 5:34095
Thomas, C.E., *See* Milora, S.L., 5:34417
Thomas, G.H., Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology, 5:34048 (SAND—80-8733)
Thomas, G.J., *See* Bruckner, L.A., 5:33267
Thomas, L.L., Mixed oxide conversion facility alternative conceptual designs, 5:33306 (AGNS—35900-CONF-71)
Thomas, M.G., Low temperature reaction path for coal liquefaction, 5:33207
Thomas, N.C., Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
Thomas, R., *See* Hastings, J.M., 5:33873
Thomson, W.J., Applied Fischer-Tropsch kinetics for a flame sprayed iron catalyst, 5:33181
Thornton, G., *See* Mills, K.A., 5:33877
Tibbs, D., *See* Johnson, D., 5:33386
Tieman, D.J., *See* Butz, T.R., 5:33304
Tietbohl, G.L., *See* Moszynski, J.R., 5:33641
Tillinghast, W.S., *See* Nolan, C.E. Jr., 5:34026
Timbario, T.J., *See* Rentz, R.L., 5:33846
Tinkham, M., Junctions - types, properties, and limitations, 5:33991
Tison, D.L., Productivity and species composition of algal mat communities exposed to a fluctuating thermal regime, 5:34194 (DP-MS—80-37)
Tison, R.R., *See* Escher, W.J.D., 5:33350, 5:33351
See Foster, R.W., 5:33353
Tisone, G.C., *See* Hoffman, J.M., 5:34032
Tobak, J.P., The application of dc-dc energy conversion in a solar energy system. Final report, 5:33441 (AD-A—077112)
Toburen, L.H., Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
Todd, R.A., Compensated count rate circuit for portable Geiger-Mueller survey meter, 5:34089

Todreas, N.E., Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
Toennisson, R.L., *See* Schnell, R.L., 5:33438
Tombrello, T.A., *See* Bacher, A.D., 5:34316
Toots, J., *See* Holdeman, L.B., 5:33980
Toplosky, J., *See* Ritchie, R.O., 5:33858
Topouzian, A., Double seal for sodium sulfur battery, 5:33658
Torok, R., *See* Muller, T., 5:33513
Toth, K.S., Decay of ^{146}Tb and the lowest 2^+ state in ^{146}Gd, 5:34332
Toth, L.E., *See* Buitrago, R., 5:34009
Touma, R.G., *See* Johnson, J.A., 5:33262
Touya, J.J., *See* Erickson, J.J., 5:34173
Toy, W., *See* Aitkenhead, W., 5:34296
Traeger, R.K., *See* Thomas, M.G., 5:33207
Trauger, D.B., Three Mile Island: then and now, 5:33633 (DOE/TIC—11235)
Trauth, C.A. Jr., *See* Sorenson, J.B., 5:33675
Trentalange, S., Shape parametrization for liquid-drop studies, 5:34362
Triegel, E.K., Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
Tromp, R.L., *See* Maeck, W.J., 5:33617
Tsarenko, A.I., *See* Bulatov, O.G., 5:33827
Tsugawa, R.T., *See* Souers, P.C., 5:33346
Tucker, B.A., *See* Chiao, R.Y., 5:33989
Tuft, D.B., Computer design of a high explosive velocity augmented kinetic energy penetrator, 5:33957 (UCRL—83559)
Numerical analysis of laminar forced convection in a spherical annulus, 5:34034 (UCRL—84655)
Turcotte, R.P., *See* Olsen, L.C., 5:33405
Turland, B.D., General formulation of the isotherm migration method for reactor accident analysis, 5:33631 (CLM-P—582)
Turnbull, R.W., *See* Steinborn, T.L., 5:33337
Turneaure, J.P., *See* Stein, S.R., 5:33982
Turner, J.A., Photoelectrochemistry with p-Si electrodes: Effects of inversion, 5:33936
Turner, L., Incomplete relaxation and finite beta plasmas, 5:34402 (LA-UR—80-2043)
Tuthill, W.A., *See* SethuRaman, S., 5:34110
Tyner, C.E., *See* Hommert, P.J., 5:33293

U

Ueland, M., Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
Ulrich, B.T., Differential heterodyne frequency conversion at 0.4 mm wavelength, 5:33990
Unny, T.E., *See* McBean, E.A., 5:34159, 5:34160
Uppuluri, V.R.R., Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)

V

Vachon, W.A., Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report, 5:33586 (AD-A—076975)
Vaglio, R., *See* Barone, A., 5:34000
Vaisnys, A., Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume I. Summary final report, 5:33606 (JPL-PUBL—80-48(Vol.1))
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume II. Supporting data and analyses, 5:33607 (JPL-PUBL—80-48(Vol.2))
Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses, 5:33740 (JPL-PUB—80-48(Vol.2))
Van Dam, T., Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
van de Kamp, P.C., *See* Lyons, D.J., 5:33554
van der Heijden, R.W., *See* Ulrich, B.T., 5:33990
van Dyck, O.B., Medium-energy physics program. Progress report, February 1-April 30, 1979, 5:34066 (LA—8257-PR)
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR, pp 28-34)
van Oers, W.T.H., *See* Brown, R.E., 5:34313
Van Vlack, L.H., *See* McCollister, H., 5:33915
Vander Molen, R.H., *See* Goblirsch, G., 5:33237
Vandersande, J.B., *See* Berthelet, C., 5:33903
Vanderwater, D.A., DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
See Blazey, K.W., 5:34251
Vanderwerf, D.F., Linear echelon refractor/reflector solar concentrators, 5:33529
Varma, M.N., Microdosimetric measurements for photons in a water phantom, 5:34367 (BNL—28157)
Varmazis, C., *See* Lukens, J.E., 5:33994
See Sandell, R.D., 5:33998
Varnado, G.B., *See* Ericson, D.M. Jr., 5:33612
Varpetyan, V.S., Research and optimization of static operating conditions for battery-powered electric automobiles, 5:33829 (DOE-tr—235)
Vary, J.P., *See* Aguilera-Navarro, V.C., 5:34350
Veneruso, A.F., High temperature hybrids for use up to 275°C - drift and lifetime, 5:33565 (SAND—80-0444C)
Verderber, R., Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
Verdier, R., *See* Aitkenhead, W., 5:34296
Verkade, M.E., Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
Vernet, G., *See* Adde, R., 5:33987
Verschueren, J.M.V., *See* Ulrich, B.T., 5:33990
Victor, R.A., Technical evaluation of the proposed technical specification change for the North Anna Nuclear Power Station, Unit 1, 5:33626 (UCID—18672)
Viehboeck, F., *See* Maresch, O., 5:33958, 5:33959
Viescas, A.J., *See* Burleson, G.R., 5:34318
Visness, R.D., Overview of Twin Cities district-heating studies, 5:33805 (CONF-790401—, pp 35-43)
Visscher, W.M., Application of MOOT to scattering of elastic waves from compound inclusions, 5:34046 (LA-UR—80-2039)
Vo-Dinh, T., Use of a fiber-optics skin contamination monitor in the workplace, 5:33240 (CONF-800814—13)
Vogilin, G.E., *See* North, G.G., 5:34054
Vogts, A., *See* Schaefer, H.G., 5:33213
Vollmer, H.J., *See* Yang, E.S., 5:34060
von Holle, W.G., Temperature measurements of shocked energetic materials by time-resolved infrared radiometry, 5:34106 (UCRL—84587)
Votta, L., *See* Aitkenhead, W., 5:34296
Vukovich, F.M., *See* Bach, W.D. Jr., 5:33381

W

Wade, W.H., *See* Bourrel, M., 5:33243
Wadehra, J.M., Large-momentum-transfer limit of some matrix elements, 5:34261
Waggoner, M.C., *See* Harrar, J.E., 5:33923
Wagner, J.R., Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
Wagner, K., *See* Deno, N.C., 5:33199, 5:33200
Wagoner, J.L., *See* Steinborn, T.L., 5:33337
Wahl, R.R., *See* Healey, D.L., 5:34224
Waidl, J.O., *See* Porch, W.M., 5:34133
Waldner, F., *See* Aitkenhead, W., 5:34296
Waldo, Time dependent beta-delayed neutrons from fissioning systems, 5:34349 (UCID—18577, pp 19-20)
Walford, G., *See* Costrell, L., 5:34091
Walker, P.L. Jr., Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
Walko, R.J., 10^{13}/second 14 MeV neutron generator for cancer therapy, 5:34084 (SAND—80-1388C)
Wallace, L.G., *See* Roen, J.B., 5:33288
Wallace, N.D., Cogeneration of electricity in the St. Louis region: industrial potential, 5:33797 (CUERS-Report—10)
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)
Walsh, F., Cathode catalyst for primary phosphoric acid fuel cells. Fourth quarterly report, April-June, 1980, 5:33756 (DOE/NASA/0150—80/4)
Walsh, J.J., Energy-related perturbations of the northeast coastal zone: five years (1974-1979) of oceanographic research at Brookhaven National Laboratory, 5:34163 (BNL—51211)
Walsh, J.P., *See* Barr, R., 5:33458
Walter, F.J., *See* Costrell, L., 5:34091
Wang, C.B., *See* Netzel, T.L., 5:34167
Wang, D., Raman and fluorescent scattering by molecules embedded in dielectric spheroids, 5:34391
Wang, J.C., *See* Bates, J.B., 5:34245
Wang, J.M., Single bunch fast longitudinal instability, 5:34068 (BNL—27971)
See Courant, E.D., 5:34069
Wang, K.Y., *See* Paik, H.J., 5:33978
Wang, L.K., *See* Barr, D.W., 5:34001
See Galfo, C.H., 5:34002
Ward, S.H., *See* Glenn, W.E., 5:33555
Ward, T.E., *See* Rasmussen, J.O., 5:34338
Warshawsky, D., Exploratory research on mutagenic activity of coal-related materials, 5:34201 (DOE/ET/00222—4)
Warszawski, B., Air battery and electrochemical method, 5:33645
Watson, W.B., Simulation study of the configuration dependent performance

of a prioritized, CSMA broadcast network, 5:34452 (UCRL—84446)
Watts, H.A., *See* Hickox, C.E., 5:34036
Watts, R.K., *See* Blocker, T.G., 5:33992
Waxler, R.M., Piezooptic coefficients of four neodymium-doped laser glasses, 5:33918
Wayland, J.R., Effects of insulation for the steam string of the TS-1S experiment, 5:33292 (SAND—80-0777)
FY 80 heavy oil program. Second quarterly report, April 1980, 5:33248 (SAND—80-1019)
Wear, F.C., Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
Weaver, H.J., *See* Murray. R.C., 5:34222
Webb, R.L., Parametric analysis of the performance of internally finned tubes for heat exchanger application, 5:34041
Weber, D.D., Natural convective heat transfer through an aperture in passive solar heated buildings, 5:33480 (LA-UR—80-2328)
Weber, S.F., Effect of resource impact factors on energy conservation standards for buildings, 5:33768 (NBS-BSS—114)
Weeks, R.A., *See* Woosley, J.D., 5:33910
Wei, D., *See* Siyu, W., 5:33558
Wei, R.P., Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
Weimer, R.F., Rates of light gas production by devolatilization of coals and lignite, 5:33211
Weisenmiller, R.B., *See* Marcus, W.B., 5:33739
Weiser, G., *See* Booth, D.C., 5:33534
Weisheit, J.C., X-ray heating and ionization of broad-emission-line regions in QSO's and active galaxies, 5:34236 (PPPL—1683)
Weiss, R., *See* Barr, R., 5:33458
Welker, J.R., *See* Johnson, D.W., 5:33270
Welker, N.K., Digital Josephson technology: present and future, 5:34013
Wells, J.C. Jr., High-spin states and band structure in ^{76}Se, 5:34327
Wenlan, S., *See* Benshan, W., 5:33242
Weseman, M., Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)
West, D.C., *See* Shugart, H.H., 5:34145
Westbrook, C.K., Modeling of flame properties of methanol, 5:33358 (CONF-790520—, pp I.12.1-I.12.10)
Westlake, D.G., Resistivity due to hydrogen in transition metal alloys, 5:33882
Weston, R.E. Jr., *See* Wolk, G.L., 5:34247
Weyhmann, W.V., *See* Goldman, A.M., 5:34378
Whalen, J., *See* Smith, A., 5:34337
Whalley, W., *See* Ramsbottom, E., 5:33655
Wharton, W.R., Gamow-Teller sum rules and the ^{14}C(^{6}Li,^{6}He)^{14}N reaction, 5:34323
Wheelock, K.S., *See* Gladrow, E.M., 5:33255
White, Fission cross section of ^{245}Cm, 5:34347 (UCID—18577, pp 12-13)
See Howe, 5:34348
White, C.W., *See* Zehner, D.M., 5:33916
White, D.H., Critical review of a quantitative study of a specialty in high energy particle physics, 5:34392 (BNL—28145)
White, H.M., *See* Ecklund, E.E., 5:33842
White, J.R., Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
White, S.N., *See* Cool, R.L., 5:34272
Whitney, J.B. III, *See* Popp, R.A., 5:34228
Whittle, D.P., High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
Wiedersich, H., *See* Lam, N.Q., 5:33896
Wiegand, D.A., *See* Garrett, W., 5:33935
Wiesner, H.J., Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
Wiffen, F.W., *See* Cox, B.L., 5:33892
Wikswo, J.P. Jr., Optimization of SQUID differential magnetometers, 5:33974
Wiktor-Jedrzejczak, W., *See* Sulek, K., 5:34189
Wilde, E.W., *See* Tison, D.L., 5:34194
Wilkes, P., *See* Lott, R.G., 5:33897
Williams, A.B., *See* Alt, R.D., 5:33836
Williams, D.E., *See* Schmidt, F.A., 5:33404
Williams, M.W., *See* Arakawa, E.T., 5:34097
Williamson, A.D., *See* Cooper, C.D., 5:34246
Williamson, S.J., Biomedical applications of SQUIDs, 5:33969
Williford, M., *See* Messina, M.G., 5:33435
Wilson, D.G., *See* Eklund, N., 5:34388
Wilson, E.H., *See* Ashare, E., 5:33431
Wilson, J.V., *See* Anderson, T.D., 5:33451
Wilson, K., *See* Goblirsch, G., 5:33237
Wilson, R., Daily risks of life, 5:33678 (CONF-800212—, pp 5-21)
Wilson, R.J., Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow, 5:33611 (DOE/ET/34209—T1)
Wilson, W., *See* Schwartz, L., 5:33598
Wilson, W.E., *See* Toburen, L.H., 5:34257
Winkler, G., *See* Smith, A., 5:34337
Winslow, S.G., *See* Pruett, J.G., 5:34126
Winter, B.L., *See* Duraiswamy, K., 5:33180
Winterberg, J., *See* Selove, W., 5:34094
Winzenried, R.W., *See* Hendrickson, R.R., 5:33572, 5:33573
Wirth, G.R., *See* Harrison, J.L., 5:34102
Wise, K.D., *See* Solomon, D.E., 5:33345
Wiser, W.H., *See* Chung, K.E., 5:33217
Witherspoon, F.D., *See* Biddle, A.P., 5:34435
Withrow, C., Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide), 5:33561 (DOE/ID/12079—3)
Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide), 5:33562 (DOE/ID/12079—6)
Witkowski, R.E., *See* Gass, W.R., 5:33409, 5:33410
Witten, E., *See* Coleman, S., 5:34298
Wolf, E.L., Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
Wolf, L., *See* Todreas, N.E., 5:33616
Wolf, S.A., *See* Deaver, B.S. Jr., 5:33961
See Peters, R.A., 5:33972
Wolfe, J.P., *See* Gourley, P.L., 5:34373
Wolk, G.L., Infrared multiphoton excitation and inverse electronic relaxation in SO_2, 5:34247
Wong, C., *See* Grimes, S.M., 5:34329
Wong, C.P.C., *See* Cheng, E.T., 5:34418
Wong, K., Current generation by unidirectional lower hybrid waves in the ACT-1 toroidal device, 5:34412
Wong, W.T., *See* Tang, I.N., 5:34161
Woo, C.K., *See* Johnson, D., 5:33386
Woo, J.T., *See* Hickok, R.L., 5:34397
See Price, R.E., 5:34394
Wood, C., *See* Woosley, J.D., 5:33910
Woodard, H.Q., Radiation carcinogenesis in man. A critical review, 5:34186 (EML—380)
Woodard, J.B., Optimal dispatch of storage for solar plants in a conventional electric grid, 5:33450 (DOE/JPL—1060-12(Vol.2), pp 123-137)
Woodruff, P.R., Measured cross sections for the photoionization of ground state He to He^+ (n=2), 5:34248
Woody, N.D., *See* Shields, J.D., 5:34154
Wool, H., Labor outlook for the bituminous coal mining industry. Final report, 5:33706 (EPRI-EA—1477)
Woosley, J.D., Photoelectric effects in magnesium aluminum spinel, 5:33910
Wormley, D.N., *See* Goldschmied, F.R., 5:33590
Wray, W.O., Sensitivity of direct gain performance to detailed characteristics of the living space, 5:33478 (LA-UR—80-2266)
Wright, J.A., *See* Schlessinger, L., 5:34404
Wright, K.L., *See* Thomson, W.J., 5:33181
Wright, T.P., Theoretical multiple beam overlap from channel transport of intense particle beams, 5:34429
See Halblcib, J.A. Sr., 5:34430
Wu, C.M., *See* Yang, E.S., 5:34060
Wuebbles, D.J., Treatment of dynamical processes in two-dimensional models of the troposphere and stratosphere, 5:34132 (UCID—18771)
Wuttke, G.H., *See* Solomon, D.E., 5:33345

Y

Yalcintas, M.G., Estimating the risk associated with computerized tomography doses, 5:34185 (CONF-791103—81)
Yamagishi, Y., *See* Matsumoto, S., 5:33630
Yamamoto, K., *See* Takahashi, T., 5:33622
Yamanouchi, T., Upper limits on phi phi production in 350 GeV/c proton-beryllium collisions, 5:34281 (FERMILAB-CONF—80/57-EXP)
Yaney, P.P., Combustion diagnostics using laser spontaneous-Raman scattering. Final report, 1 July 1976-31 October 1978, 5:33940 (AD-A—076514)
Yang, E.S., Schottky barrier formation by laser irradiation processing, 5:34060
Yanik, S.J., *See* Frayer, J.A., 5:33253
Yao, K., Energy consumption: case of the Ivory Coast, Senegal and Ghana, 5:33743
Yatabe, J.M., *See* Carlson, M.C.J., 5:33619
Yates, W.G., Radon monitoring program, February-April 1980, 5:34139 (MLM—2758)
Yayanos, A.A., *See* Anderson, D.R., 5:33336
Yevak, R., *See* Deno, N.C., 5:33200
Yevak, R.J., *See* Deno, N.C., 5:33199
Yewell, M.R. Jr., *See* Lloyd, W.G., 5:33216
Yodh, G.B., Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957, pp 139-193)
Yoshizaki, S., *See* Chiotti, P., 5:34124
Yost, B., *See* Selove, W., 5:34094
Young, E.G., User guide for transferring data from NOS (Network Operating System) to Applicon Graphics System, 5:34448 (SAND—80-1124)
Young, R., *See* Berk, J.V., 5:33778
Yu, J.M., Surface self-diffusion of vanadium, 5:33867 (IS-T—925)
Yung, D., Vapor/liquid interaction and entrainment in falling film evaporators, 5:34266

Z

Zalkin, A., *See* Perry, D.L., 5:33938

Zappe, H.H., Superconductive electronics in future computer designs, 5:34018
Zasadzinski, J., *See* Wolf, E.L., 5:33872
Zawicki, L.R., *See* Thomas, N.C., 5:34053
Zehner, D.M., Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
Zenty, S., Photolytic process for gasification of carbonaceous material, 5:33178
Zhaoping, L., *See* Benshan, W., 5:33242
Zheglov, V.A., *See* Labuntsov, V.A., 5:33831
Zielinski, R.E., Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1980, 5:33289 (MLM-MU—80-68-0002)
Zielke, C.W., Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal, 5:33209
Zimmerman, J.E., Cryocoolers for superconductive electronics, 5:34011
Zimmerman, R.M., Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
Zimmermann, W. Jr., *See* Goldman, A.M., 5:34378
Zisman, M.S., *See* Logan, D., 5:34336
Zivi, S.M., Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
Zonov, V.N., *See* Kazanskii, V.M., 5:33828
Zunger, A., Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
Zverev, G.A., System of regulating an electric automobile with an induction traction motor, 5:33833 (DOE-tr—240)
Zwier, J., *See* Daalmans, G.M., 5:33995

SUBJECT INDEX

The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR/QUALIFIER
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

A

A-15 COMPOUNDS
See BETA-W LATTICES

A2H-1320 RESONANCES/RADIATIVE DECAY
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)

ABANDONED SITES/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)

ACCELERATORS
See also FERMILAB ACCELERATOR
LAMPF LINAC
LINEAR ACCELERATORS
MICROTRONS
STORAGE RINGS

ACCELERATORS/BEAM TRANSPORT
Pulsed magnetic field distribution near conducting rings, 5:34426 (SAND—80-1546)

ACCELEROMETERS/SQUID DEVICES
Superconducting gravity gradiometers, 5:33978

ACETALDEHYDE/ATOM-MOLECULE COLLISIONS
Reactions with oxygen atoms, 5:33922 (BNL—50973)

ACETONE/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)

ACETYLENE/PRODUCTION
Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas (Patent), 5:33356

ACID ELECTROLYTE FUEL CELLS/DESIGN
Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979, 5:33752 (DOE/ET/11300—T2)
Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979, 5:33750 (DOE/ET/11300—1)
Cell and stack design alternatives. Fourth quarterly report, May 1 1979-July 29, 1979, 5:33749 (DOE/ET/11300—)
Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979, 5:33751 (DOE/ET/11300—T1)
Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979, 5:33753 (DOE/ET/11300—T3)

ACID ELECTROLYTE FUEL CELLS/ELECTROCATALYSTS
Cathode catalyst for primary phosphoric acid fuel cells. Fourth quarterly report, April-June, 1980, 5:33756 (DOE/NASA/0150—80/4)

ACID RAIN/DATA BASE MANAGEMENT
Workshop: data management needs for atmospheric deposition, 5:34122 (EPRI-WS—79-163)

ACID RAIN/ENVIRONMENTAL IMPACTS
Acid precipitation and the aquatic environment, 5:34162 (BNL—28173)

ACID RAIN/POLLUTION ABATEMENT
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)

ACTINIDE NUCLEI/NEUTRON REACTIONS
Time dependent beta-delayed neutrons from fissioning systems, 5:34349 (UCID—18577)

ACTINIDES/RADIOACTIVE WASTE PROCESSING
Recovering actinide values (Patent), 5:33322

ACTINIDES/SOLVENT EXTRACTION
Recovering actinide values (Patent), 5:33322

ACTINIDES/TRANSMUTATION
Transmutation of radwaste using accelerators, 5:33321 (RHO-SA—174)

ACTIVATED CARBON/SORPTIVE PROPERTIES
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)

ACTIVATED SLUDGE PROCESS/BENCH-SCALE EXPERIMENTS
Biological treatment of Grand Forks Energy Technology Center slagging fixed-bed coal gasification process wastewater. Eleventh quarterly report, March 1979, 5:33220 (FE—2496-42)

ADIP PROCESS
Acid gas removal by versatile Shell processes, 5:33283

ADOBE/HEAT TRANSFER
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)

ADSORBENTS
See also ACTIVATED CARBON

ADSORBENTS/REGENERATION
Sorbent regeneration in a process for removing sulfur-containing impurities from mineral oils (Patent), 5:33257

AERODYNAMICS/TURBULENCE
Turbulence spectrum observed by a fast-rotating wind-turbine blade, 5:33584 (PNL—3426)

AEROSOLS/SCAVENGING
Gas and aerosol scavenging, 5:34130 (PNL-SA—8170)

AFFIRMATIVE ACTION/COMPLIANCE
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)

AGRICULTURAL RESIDUES
See AGRICULTURAL WASTES

AGRICULTURAL WASTES
See also MANURES

AGRICULTURAL WASTES/ANAEROBIC DIGESTION
Feasibility study for anaerobic digestion of agricultural crop residues. Dynatech report No. 1935, 5:33431 (SERI/TR—8157-1-T1)

AGRICULTURAL WASTES/ENERGY SOURCE DEVELOPMENT
Energy from biological processes, 5:33429 (OTA-E—124)
AGRICULTURAL WASTES/RECYCLING
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)
AGRICULTURAL WASTES/RESOURCE POTENTIAL
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
AGRICULTURE
See also FARMS
AGRICULTURE/ENERGY DEMAND
Make better use of energy: energy budgeting in farming, 5:33792 (NP—25047)
AGRICULTURE/HEAT RECOVERY EQUIPMENT
Useful heat from waste heat, 5:33799 (NP—24997)
AGRICULTURE/RECYCLING
Organic recycling in agriculture, 5:33814 (NP—25012)
AIR CONDITIONERS
See also SOLAR AIR CONDITIONERS
AIR CONDITIONERS/LATENT HEAT STORAGE
Development of intermediate temperature thermal storage systems. Final technical report, April 1, 1978-May 31, 1979, 5:33641 (DOE/CS/35760—T1)
AIR CONDITIONING
See also ANNUAL CYCLE ENERGY SYSTEM
SOLAR AIR CONDITIONING
AIR CONDITIONING/ENERGY DEMAND
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
AIR FILTERS/PERFORMANCE
Electrostatic fibrous air filters: a theoretical study. Final report, 5:34022 (UCRL—15137)
AIR FILTERS/PRESSURE DROP
Electrostatic fibrous air filters: a theoretical study. Final report, 5:34022 (UCRL—15137)
AIR POLLUTION
See also INDOOR AIR POLLUTION
AIR POLLUTION/DIFFUSION
Measurements of jet dispersions simulated in an aeronautical wind tunnel, 5:34114 (AD-A—076578)
AIR POLLUTION/ENVIRONMENTAL IMPACTS
Terrestrial perturbation experiments as an environmental assessment tool, 5:33679 (ORNL/TM—7186)
AIR POLLUTION/MATHEMATICAL MODELS
Hybrid regional air pollution models, 5:34131 (PNL-SA—8431)
AIR POLLUTION/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
Long path optical extinction and meteorology in the San Francisco Bay Area, 5:34133 (UCRL—84339)
AIR POLLUTION ABATEMENT/COMPLIANCE
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
AIR POLLUTION ABATEMENT/TECHNOLOGY UTILIZATION
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
AIR POLLUTION CONTROL
Adsorption of moisture by grain dust and control of dust hazards, 5:34124 (IS-M—285)
AIR POLLUTION MONITORS/DESIGN
Development of a particulate sulfate analyzer. Final report, 5:34120 (EPRI-EA—1492)
AIR QUALITY
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
AIR QUALITY/MATHEMATICAL MODELS
Air quality regulation in spatial equilibrium models, 5:34141 (LA-UR—80-1753)
Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
AIRCRAFT/FUEL SUBSTITUTION
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
AIRCRAFT/FUELS
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
ALABAMA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
ALABAMA/SURFACE MINING
Environmental control technology survey of selected US strip mining sites. Volume 2B. Alabama. Water quality impacts and overburden chemistry of Alabama study site, 5:33224 (ANL/EMR—2(Vol.2B))
ALARM SYSTEMS/DESIGN
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
ALARM SYSTEMS/OPERATION
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
ALASKA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
ALCATOR DEVICE/ELECTROMAGNETIC RADIATION
Observations of fluctuating ω/sub p/ emission in Alcator tokamaks, 5:34411
ALCOHOL FUELS
See also ETHANOL FUELS
METHANOL FUELS
ALCOHOL FUELS/ECONOMIC ANALYSIS
Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
ALCOHOL FUELS/ENERGY SOURCE DEVELOPMENT
Energy from biological processes, 5:33429 (OTA-E—124)
ALCOHOL FUELS/ENVIRONMENTAL IMPACTS
Environmental planning and assessment for highway vehicle use of alcohol fuels, 5:34111 (CONF-790520—)
ALCOHOL FUELS/MEETINGS
Third international symposium on alcohol fuels technology, 5:33415 (CONF-790520—)
ALCOHOL FUELS/PRODUCTION
Alcohol Fuels Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33360
Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
ALCOHOL FUELS/RESOURCE POTENTIAL
Alcohol Fuels Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33360
ALCOHOL FUELS/TECHNOLOGY ASSESSMENT
Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—)
ALCOHOLS
See also BUTANOLS
ETHANOL
GLYCOLS
METHANOL
PROPANOLS
ALCOHOLS/SYNTHESIS
Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. Second quarterly progress report, January 1-March 31, 1980, 5:33361 (DOE/ET/14858—2)
ALGAE/PRODUCTIVITY
Productivity and species composition of algal mat communities exposed to a fluctuating thermal regime, 5:34194 (DP-MS—80-37)
ALGAE/TAXONOMY
Productivity and species composition of algal mat communities exposed to a fluctuating thermal regime, 5:34194 (DP-MS—80-37)
ALGORITHMS
Block relaxation strategies, 5:34445 (LA-UR—80-2342)
ALGORITHMS/EVALUATION
Computational experience with an explicit difference scheme for a one phase Stefan problem, 5:34388 (ORNL/CSD—62)
ALKALI METAL COMPOUNDS/REMOVAL
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
ALKANES
See also BUTANE
2-2-DIMETHYLPROPANE
METHANE
PROPANE
ALKANES/NUCLEAR MAGNETIC RESONANCE
High resolution NMR spectroscopy: its application to shale oil component/type analysis, 5:33298
ALKENES
See also CAMPHENE
ETHYLENE

ALKENES/NUCLEAR MAGNETIC RESONANCE
High resolution NMR spectroscopy: its application to shale oil component/type analysis, 5:33298
AI LOCATIONS/ENVIRONMENTAL IMPACTS
Environmental assessment: allocation of petroleum feedstock, Columbia LNG Corporation, Green Springs SNG Plant, Green Springs, Seneca County, Ohio, 5:33269 (DOE/EA—0061)
ALLOY 800
See INCOLOY 800
ALLOY-HD-556/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-HD-556/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-HD-556/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-HD-8077
See NICKEL BASE ALLOYS
ALLOY-HK-40/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-HK-40/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-HK-40/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-519/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-519/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-519/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-738/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-738/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-IN-738/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MA-754
See NICKEL BASE ALLOYS
ALLOY-MM-0011
See IRON BASE ALLOYS
ALLOY-MM-0011/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MM-0011/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MM-0011/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MO-RE-2/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MO-RE-2/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-MO-RE-2/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-NX-188/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-NX-188/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-NX-188/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-TZM/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-TZM/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-TZM/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
ALLOY-TZM/PHYSICAL RADIATION EFFECTS
Ductility in bending of molybdenum alloys irradiated between 425 and 1000°C, 5:33892
ALLOY-WAZ-16
See NICKEL BASE ALLOYS
ALPHA PARTICLES/BINDING ENERGY
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
ALPHA REACTIONS/ELASTIC SCATTERING
Nucleus-nucleus total reaction cross sections, 5:34317
ALPHA REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
ALTERNATE FUELS
See FUEL SUBSTITUTION
SYNTHETIC FUELS
ALUMINA
See ALUMINIUM OXIDES
ALUMINATES/CREEP
Creep of 90+ % Al_2O_3 refractory concrete, 5:33904
ALUMINATES/FABRICATION
Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980 ($LiAlO_2$), 5:33754 (SAN—11276-4)
ALUMINATES/PRECIPITATION
Magnesium aluminate spinel precipitation in MgO, 5:33903
ALUMINIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
ALUMINIUM/CORROSION RESISTANCE
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
ALUMINIUM/ELECTROPLATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
ALUMINIUM/MACHINING
Preliminary study of high-speed machining, 5:33946 (BDX—613-2401)
ALUMINIUM/SURFACE COATING
Uniform aluminum deposits on large nonplanar and planar polyimide substrates by physical vapor deposition, 5:33850 (BDX—613-2397)
ALUMINIUM/SURFACE PROPERTIES
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
ALUMINIUM/THICKNESS
Uniform aluminum deposits on large nonplanar and planar polyimide substrates by physical vapor deposition, 5:33850 (BDX—613-2397)
ALUMINIUM 27 TARGET/PION MINUS REACTIONS
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
ALUMINIUM 27 TARGET/TRITON REACTIONS
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)
ALUMINIUM ALLOYS
See also ALUMINIUM BASE ALLOYS
ALUMINIUM ALLOYS/CORROSION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)

Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
ALUMINIUM ALLOYS/CORROSION PROTECTION
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
ALUMINIUM ALLOYS/DEFORMATION
Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865
ALUMINIUM ALLOYS/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
ALUMINIUM ALLOYS/OXIDATION
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
ALUMINIUM ALLOYS/PHYSICAL RADIATION EFFECTS
Tensile properties of high oxide SAP containing helium and tritium, 5:33898
ALUMINIUM ALLOYS/SURFACE PROPERTIES
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
ALUMINIUM BASE ALLOYS/CORROSION PROTECTION
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
ALUMINIUM COMPOUNDS/PHOTOELECTRIC EFFECT
Photoelectric effects in magnesium aluminum spinel, 5:33910
ALUMINIUM OXIDES
See also SPINELS
ALUMINIUM OXIDES/ADHESION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
ALUMINIUM OXIDES/CATALYTIC EFFECTS
Cobalt-molybdenum-alumina desulfurization catalyst (Patent), 5:33254
Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix (Patent), 5:33260
Hydrocarbon cracking catalyst (Patent), 5:33255
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
Sulfur oxides control in catalytic cracking (Patent), 5:33272
ALUMINIUM OXIDES/CREEP
Creep of 90+ % Al_2O_3 refractory concrete, 5:33904
ALUMINIUM OXIDES/CRYSTAL STRUCTURE
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
ALUMINIUM OXIDES/DIP COATING
Photoresist dip coating on thin film networks. Final report, 5:33901 (BDX—613-2398)
ALUMINIUM OXIDES/F CENTERS
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
ALUMINIUM OXIDES/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
ALUMINIUM OXIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
ALUMINIUM OXIDES/PHYSICAL PROPERTIES
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
ALUMINIUM OXIDES/RECOVERY
Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
Power plant fly ash as a resource for alumina and cement, 5:33222 (IS-M—289)
ALUMINIUM OXIDES/SURFACE COATING
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
Investigation of several commercial aluminide coatings for carburization protection of a nickel-base alloy, 5:33886 (GA-A—15825)
ALUMINIUM PHOSPHATES/CATALYTIC EFFECTS
Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix (Patent), 5:33260
ALUMINIUM SILICATES
See also SMECTITE
ALUMINIUM SILICATES/CRACKS
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
ALUMINIUM SILICATES/CRYSTAL STRUCTURE
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
AMBIENT TEMPERATURE/CALCULATION METHODS
Solar index prediction methodology preliminary analysis, 5:33384 (DOE/ET/20090—4)
AMERICIUM/SORPTION
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
AMERICIUM 241/ION EXCHANGE
Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory, 5:33928 (LA-UR—80-2414)
AMERICIUM 241/PRECIPITATION
Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory, 5:33928 (LA-UR—80-2414)
AMERICIUM 241/PURIFICATION
Status of ^{241}Am recovery and purification at Los Alamos Scientific Laboratory, 5:33928 (LA-UR—80-2414)
AMERICIUM 242 TARGET/NEUTRON REACTIONS
Fission neutron multiplicity for /sup 242m/Am (0 to 30 MeV), 5:34348 (UCID—18577)
AMES TEST
See MUTAGEN SCREENING
AMINES
See also HYDROXAMIC ACIDS
AMINES/CHEMICAL ANALYSIS
Amine gas treating solution analysis: a tool in problem solving, 5:33281
AMINOGLYCIDES
See AMINES
AMMONIA/CHEMICAL PREPARATION
Process for hydrogen recovery from ammonia purge gases (Patent), 5:33364
ANAEROBIC DIGESTION
See also BIOGAS PROCESS
ANAEROBIC DIGESTION/FEASIBILITY STUDIES
Feasibility study for anaerobic digestion of agricultural crop residues. Dynatech report No. 1935, 5:33431 (SERI/TR—8157-1-T1)
ANGIOGRAPHY
See BIOMEDICAL RADIOGRAPHY
ANHARMONIC OSCILLATORS/CORRELATION FUNCTIONS
Strong coupling expansion for classical statistical dynamics, 5:34389
ANIMAL CELLS
See also NERVE CELLS
ANIMAL CELLS/CHROMOSOMAL ABERRATIONS
Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
ANIMAL CELLS/GENE MUTATIONS
Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
ANIMAL CELLS/SISTER CHROMATID EXCHANGES
Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
ANIMAL SHELTERS/GEOTHERMAL SPACE HEATING
User manual for geothermal energy assisted dairy complex computer programs: PREBLD, MODEL0, MODEL1, MODEL2, FRMAT2, PREPI2, NET2, DAIRY and DAIRY1, 5:33581 (DOE/ET/28434—T1)
ANIMALS
(See also specific animal names.)
See also INVERTEBRATES
ANIMALS/BIOLOGICAL RADIATION EFFECTS
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
ANNUAL CYCLE ENERGY SYSTEM/ECONOMIC ANALYSIS
Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices, 5:33769 (ORNL/Sub—7470/1-V3)
ANNUAL CYCLE ENERGY SYSTEM/EVALUATION
Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles, 5:33802 (ANL/CNSV-TM—40)
ANNUAL ENERGY STORAGE/COMPUTERIZED SIMULATION
Value of seasonal storage of solar energy, 5:33543 (DOE/JPL—1060-12(Vol.2))
ANNULAR SPACE/HEAT TRANSFER
Numerical analysis of laminar forced convection in a spherical annulus, 5:34034 (UCRL—84655)
ANNULAR SPACE INCOMPRESSIBLE FLOW
Numerical analysis of laminar forced convection in a spherical annulus, 5:34034 (UCRL—84655)
ANTENNAS
See also RADIO EQUIPMENT
ANTENNAS/IMPEDANCE
Admittance of an infinitely long monopole antenna immersed in a dissipative medium and driven by a coaxial line with a nondissipative dielectric bead in the end, 5:34057 (SAND—79-1490)
Admittance of an infinitely long monopole antenna driven by a coaxial line, 5:34055 (SAND—78-1065)

ANTHRACITE/PRICES
Coal: Pennsylvania anthracite for the calendar year 1977, 5:33230 (DOE/EIA—0119(77))
ANTHRACITE/PRODUCTION
Coal: Pennsylvania anthracite for the calendar year 1977, 5:33230 (DOE/EIA—0119(77))
ANTHRACITE/TRADE
Coal: Pennsylvania anthracite for the calendar year 1977, 5:33230 (DOE/EIA—0119(77))
ANTIBARYONS/PARTICLE PRODUCTION
Particle ratios, quarks, and Chao-Yang statistics, 5:34287
ANTIMONY/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
ANTIMONY 133/BETA-MINUS DECAY
Determination of properties of short-lived fission products, 5:34331 (UCID—18577)
APARTMENT BUILDINGS/FUEL CELL POWER PLANTS
Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979, 5:33752 (DOE/ET/11300—T2)
Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979, 5:33750 (DOE/ET/11300—1)
Cell and stack design alternatives. Fourth quarterly report, May 1, 1979-July 29, 1979, 5:33749 (DOE/ET/11300—)
Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979, 5:33751 (DOE/ET/11300—T1)
Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979, 5:33753 (DOE/ET/11300—T3)
APARTMENT BUILDINGS/SOLAR AIR CONDITIONING
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
APARTMENT BUILDINGS/SOLAR SPACE HEATING
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
APARTMENT BUILDINGS/SOLAR WATER HEATING
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
APPROPRIATE TECHNOLOGY
See also TECHNOLOGY UTILIZATION
APPROPRIATE TECHNOLOGY/SOCIAL IMPACT
Our energy horizons: a missing perspective, 5:33676
AQUACULTURE
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
AQUACULTURE/ECONOMICS
Production and distribution of organisms in geothermal aquaculture: panel discussion, 5:33580 (ORESU-W—78-001)
AQUACULTURE/MEETINGS
Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977, 5:33548 (ORESU-W—78-001)
AQUATIC ECOSYSTEMS/BIOLOGICAL STRESS
Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report, 5:34195 (EPRI-EA—1148(Vol.1))
ARAMIDS/ACOUSTIC EMISSION TESTING
Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)
ARAMIDS/FRACTURE PROPERTIES
Failure modes and durability of Kevlar/epoxy composites, 5:33909 (UCRL—83875)
AREA POLLUTION SOURCES
See POLLUTION SOURCES
ARGON/ATOM-ATOM COLLISIONS
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
ARGON/AUTOIONIZATION
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
ARGON/ENERGY-LEVEL TRANSITIONS
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
ARGON/ION-ATOM COLLISIONS
Crossed beam studies of low energy proton transfer reactions: H_2^+(Ar,H) HAr^+ from 0.4 to 7.8 eV (c.m.), 5:34240
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
ARGON 32/MASS
Isospin quintets in the 1p and s-d shells, 5:34318
ARGON 40 REACTIONS/COMPOUND-NUCLEUS REACTIONS
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
ARGON 40 REACTIONS/FISSION
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
ARID LANDS/BIOMASS
Fuels from biomass systems for arid land environments, 5:33424 (DOE/TIC—11247)
ARIZONA/GEOCHEMICAL SURVEYS
Stream sediment detailed geochemical survey for Date Creek Basin, Arizona, 5:33304 (GJBX—164(80))
ARIZONA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
ARIZONA/POWER PLANTS
Principal electric facilities: Arizona, California, Nevada, 5:33711 (DOE/EIA—0057/9(79))
ARKANSAS/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
AROMATICS
See also CONDENSED AROMATICS
POLYCYCLIC AROMATIC HYDROCARBONS
AROMATICS/CATALYTIC REFORMING
Process for the simultaneous production of aromatic hydrocarbons and isobutane (Patent), 5:33262
AROMATICS/COMBUSTION
Cyano-arenes produced by combustion of nitrogen-containing fuels, 5:33175
AROMATICS/NUCLEAR MAGNETIC RESONANCE
High resolution NMR spectroscopy: its application to shale oil component/type analysis, 5:33298
AROMATICS/PRODUCTION
Combination process for selected aromatic hydrocarbon production (Patent), 5:33263
AROMATICS/PYROLYSIS
Thermal decomposition of aromatic substances, 5:33212
AROMATICS/SOLVENT EXTRACTION
Process for aromatics extraction from a 300 to 430°F boiling range naphtha (Patent), 5:33256
ARSENIC/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
ARSENIC/TOXICITY
Carcinogenic, mutagenic, and teratogenic effects of cadmium and arsenic, 5:34215 (BNL—51118)
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
ARSENIC/UPTAKE
Cadmium and arsenic in the environment, 5:34203 (BNL—51118)
ARTHROPODS/FOOD CHAINS
Arthropod use of invertebrate carrion, 5:34144 (DOE/EV/00641—34)
Mineral cycling in soil and litter arthropod food chains. Progress report, November 1, 1979-October 31, 1980, 5:34149 (DOE/EV/00641—37)
ARTHROPODS/POPULATIONS
Comparison of soil surface arthropod populations in conventional tillage, no-tillage and old field systems, 5:34182 (DOE/EV/00641—41)
ASBESTOS/BIBLIOGRAPHIES
Asbestos in air. A bibliography with abstracts, 1964-1980, 5:34126 (NLM/TIRC—80/2)
ASBESTOS/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
ASHES
See also FLY ASH
ASHES/CHEMICAL COMPOSITION
Influence of coal mineral matter on slagging of utility boilers. Final report, 5:33587 (EPRI-CS—1418)
ASPHALTENES/SOLVENT EXTRACTION
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
ASPHALTS
See also ASPHALTENES
ASPHALTS/PERMEABILITY
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
ASSIGNMENTS
See ALLOCATIONS
ASTROCYTOMAS
See NEOPLASMS
ATHABASCA DEPOSIT/GROUND WATER
Response of confined aquatic biota to mine depressurization water in Beaver Creek Reservoir, 5:34202 (NP—25070)
ATMOSPHERIC PRECIPITATIONS/MATHEMATICAL MODELS
Use of time averaged precipitation for wet removal in a regional air pollution assessment model, 5:34129 (PNL-SA—7658)

ATOMIC EXPLOSIONS
See NUCLEAR EXPLOSIONS
ATOMS
See also MUONIC ATOMS
ATOMS/EXCITATION
Theory of resonance-radiation pressure, 5:34264
ATOMS/INTERACTIONS
Theory of resonance-radiation pressure, 5:34264
ATOMS/RELAXATION
Theory of resonance-radiation pressure, 5:34264
ATTACHED GREENHOUSES/PERFORMANCE
Attached sunspace heating performance estimates, 5:33477 (LA-UR—80-2236)
AUSTENITIC STEELS/PHYSICAL RADIATION EFFECTS
Microstructure of single and dual-ion irradiated Fe-20Ni-15Cr and Ti-6Al-4V alloys, 5:33890
AUSTRALIA/ENERGY CONSERVATION
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
AUSTRALIA/ENERGY POLICY
Energy policy in Australia: the social/institutional context and procedures for policy formulation, 5:33703
AUSTRALIA/SOLAR ENERGY
Solar energy in Australia: a profile of renewable energy activity in its national context, 5:33377 (SERI/SP—763-717)
AUTOMOBILES/FUEL SUBSTITUTION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
AUTOMOBILES/MARKET
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
AUTOMOBILES/OPERATION
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
AXONS
See NERVE CELLS
AZIDES/PHOTOLYSIS
Optical extinction and N2 gas evolution on photodecomposition of Pb(N3)2. Final report, 1972-1975, 5:33935 (AD-A—077110)

B

B-1235 RESONANCES/LEPTONIC DECAY
tauν decay signature for detecting F^{+-} and B^{+-} mesons in e^+e^- collisions, 5:34292
BACTERIOPHAGES/RADIOSENSITIVITY
Distinction between the roles of O_2 and of O^-_2 in biological radiodamage, 5:34184 (DOE/EV/03221—68)
BAG MODEL/SECOND QUANTIZATION
Link-operator formulation of quark confinement without van der Waals forces, 5:34285
BALANCES/OPERATION
DYMAC digital electronic balance (LASL Plutonium Processing Facility), 5:33342 (LA—8313-M)
BALANCES/SENSITIVITY
Wide range high sensitivity film balance, 5:34101
BARIUM 139/BETA-MINUS DECAY
Gamma-ray emission probabilities and half-life of ^{139}Ba, 5:34333
BARSTOW SOLAR PILOT PLANT/THERMAL ENERGY STORAGE EQUIPMENT
Criteria for selection of the thermal storage system for the 10 MW(e) solar power plant to be built in Barstow, California, 5:33455 (DOE/JPL—1060-12(Vol.2))
BARYON NUMBER/CONSERVATION LAWS
Neutron oscillations and the existence of massive neutral leptons, 5:34297
BARYONS
See also ANTIBARYONS
NUCLEONS
BARYONS/PARTICLE PRODUCTION
Particle ratios, quarks, and Chao-Yang statistics, 5:34287
BASALT
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
BASALT/ION EXCHANGE
Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)
BATTERIES (ELECTRIC)
See ELECTRIC BATTERIES
BATTERY CHARGERS/DESIGN
Battery charger with liquid crystal charge current indicator (Patent), 5:33656
BAUXITE/REGENERATION
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
BAUXITE/SORPTIVE PROPERTIES
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
BAYS/MAPPING
Locations and areas of ponds and Carolina Bays at the Savannah River Plant, 5:34154 (DP—1525)
BEAM BUNCHING/STABILITY
Single bunch fast longitudinal instability, 5:34068 (BNL—27971)
BEAM-BEAM INTERACTIONS/LIMITING VALUES
Empirical model for controlling beam-beam effects in ISABELLE, 5:34070 (BNL—28033)
BEAM-PLASMA SYSTEMS/BEAM OPTICS
Theoretical multiple beam overlap from channel transport of intense particle beams, 5:34429
BEAM-PLASMA SYSTEMS/BEAM TRANSPORT
Theoretical multiple beam overlap from channel transport of intense particle beams, 5:34429
BEAM-PLASMA SYSTEMS/TRANSPORT THEORY
Relativistic-electron-beam/target interaction in plasma channels, 5:34430
BEHAVIOR
(Limited to living systems.)
BEHAVIOR/SEASONAL VARIATIONS
Biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978, 5:34158 (ORNL/TM—7127)
BELLOWS/FAILURES
Development of bellows for sodium valve in Japan (LMFBR), 5:33625 (JAPFNR—507)
BELLOWS/IN-SERVICE INSPECTION
Investigation on the reliability of expansion joint for piping with probabilistic method (LMFBR), 5:33624 (JAPFNR—506)
BELLOWS/PERFORMANCE
Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
BELLOWS/SPECIFICATIONS
Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
BENTONITE/SORPTIVE PROPERTIES
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
BERYLLIA
See BERYLLIUM OXIDES
BERYLLIUM/PROTON REACTIONS
Upper limits on phi phi production in 350 GeV/c proton-beryllium collisions, 5:34281 (FERMILAB-CONF—80/57-EXP)
BERYLLIUM/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
BERYLLIUM/TOXICITY
Toxicology of beryllium and beryllium-containing chemicals, 5:34208 (BNL—51118)
BERYLLIUM 9 TARGET/PROTON REACTIONS
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^9Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
BERYLLIUM COMPOUNDS/TOXICITY
Toxicology of beryllium and beryllium-containing chemicals, 5:34208 (BNL—51118)
BERYLLIUM MODERATORS
See BERYLLIUM
BERYLLIUM OXIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
BETA-W LATTICES/FABRICATION
A15 multifilamentary superconductors by the infiltration process, 5:34380 (LBL—10761)
BETA-W LATTICES/RESEARCH PROGRAMS
Metallurgy and Materials Science Division, 5:34376 (BNL—50973)
BINARY FISSION/LIQUID DROP MODEL
Shape parametrization for liquid-drop studies, 5:34362
BIOCONVERSION
See also ANAEROBIC DIGESTION
BIOCONVERSION/ENVIRONMENTAL IMPACTS
Energy from biological processes, 5:33429 (OTA-E—124)
BIOCONVERSION/FINANCIAL INCENTIVES
Energy from biological processes, 5:33429 (OTA-E—124)

BIOGAS PROCESS/ECONOMICS
Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
BIOGAS PROCESS/NET ENERGY
Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
BIOLOGICAL MATERIALS
(See also specific biological materials.)
See also BIOLOGICAL WASTES
BIOMASS
LEAVES
PLANTS
BIOLOGICAL MATERIALS/BIOLOGICAL RADIATION EFFECTS
Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Annual progress report, September 1979-July 1980, 5:33937 (DOE/EV/03221—67)
BIOLOGICAL MATERIALS/CHARGED-PARTICLE TRANSPORT
Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
BIOLOGICAL MATERIALS/ION-ATOM COLLISIONS
Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
BIOLOGICAL WASTES/RECYCLING
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)
BIOMASS
(All growing organic matter such as plants, trees, grasses, and algae.)
See also AGRICULTURAL WASTES
ALGAE
MAIZE
MANURES
PLANTS
SEAWEEDS
SUGAR BEETS
SUGAR CANE
TREES
WOOD
WOOD WASTES
BIOMASS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
BIOMASS/ENERGY RECOVERY
Energy Recovery from Waste and Biomass Project, 5:34062
BIOMASS/ENERGY SOURCE DEVELOPMENT
Biological applications of solar energy, 5:33428
BIOMASS/MEETINGS
Biological applications of solar energy, 5:33428
Third international symposium on alcohol fuels technology, 5:33415 (CONF-790520—)
BIOMASS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
BIOMASS/PROGRAM MANAGEMENT
Fuels from Woody Biomass Program. Quarterly report, February 1 to June 1, 1980, 5:33423 (DOE/ET/20593—T1)
BIOMASS/RECYCLING
Organic recycling in agriculture, 5:33814 (NP—25012)
BIOMASS CONVERSION PLANTS/DESIGN
Janata biogas plant, 5:33425 (NP—25010)
BIOMASS CONVERSION PLANTS/ECONOMIC ANALYSIS
Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—)
Technical and economic assessment motor fuel alcohol from grain and other biomass, 5:33416 (CONF-790520—)
BIOMASS CONVERSION PLANTS/FEASIBILITY STUDIES
Technical and economic assessment motor fuel alcohol from grain and other biomass, 5:33416 (CONF-790520—)
BIOMASS CONVERSION PLANTS/OPERATION
Janata biogas plant, 5:33425 (NP—25010)
BIOMASS PLANTATIONS/FEASIBILITY STUDIES
Fuels from biomass systems for arid land environments, 5:33424 (DOE/TIC—11247)
Potential of cattails as an energy source. Final report, 5:33434
BIOMASS PLANTATIONS/LAND USE
Wetland energy crops (Marshes and swamps), 5:33433
BIOMASS PLANTATIONS/PLANT BREEDING
Fuels from biomass systems for arid land environments, 5:33424 (DOE/TIC—11247)
BIOMASS PLANTATIONS/PLANT GROWTH
Fuels from woody biomass. First annual report, 3 April 1978-2 January 1979, 5:33422 (DOE/ET/20049—T1)
BIOMASS PLANTATIONS/WASTE PRODUCT UTILIZATION
Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
BIOMEDICAL RADIOGRAPHY/COMPARATIVE EVALUATIONS
Advances in diagnostic instrumentation, 5:34177 (LBL—9892)
BIOSYNTHESIS/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
BIRDS/POPULATIONS
1979 breeding bird censuses and summary of 1977-1979 results, 5:34142 (BNL—51161)
BITUMINOUS COAL/PRODUCTION
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
BLACK CHROME/MICROSTRUCTURE
Microstructural characterization of a black chrome solar selective absorber, 5:33536
BLACK CHROME/REFLECTIVITY
Microstructural characterization of a black chrome solar selective absorber, 5:33536
BLACK HOLES/ORIGIN
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
BLACK SHALES/GEOCHEMISTRY
Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1980, 5:33289 (MLM-MU—80-68-0002)
BLACK SHALES/STRATIGRAPHY
Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1980, 5:33289 (MLM-MU—80-68-0002)
BLACKOUTS/SOCIAL IMPACT
Sociological implications of an energy-deficient society, 5:33669 (CONF-800212—)
BLANKETS (BREEDING)
See BREEDING BLANKETS
BLOOD FORMATION/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
BNL
(Brookhaven National Laboratory.)
BNL/BIRDS
1979 breeding bird censuses and summary of 1977-1979 results, 5:34142 (BNL—51161)
BNL/ENERGY MODELS
Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL), 5:33665 (BNL—51199)
BOGS
See SWAMPS
BOILERS
See also WASTE HEAT BOILERS
BOILERS/ENERGY EFFICIENCY
Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978, 5:33773 (BNL—51171)
BOILERS/FOULING
Influence of coal mineral matter on slagging of utility boilers. Final report, 5:33587 (EPRI-CS—1418)
BOILING WATER REACTORS
See BWR TYPE REACTORS
BOLOMETERS/SUPERCONDUCTING DEVICES
Millimeter wave superconducting devices, 5:33985
BOLTZMANN COLLISION INTEGRAL
See BOLTZMANN EQUATION
BOLTZMANN EQUATION/MOMENTS METHOD
Alteration of Pfirsch—Schlueter transport in tokamaks by all four external sources, 5:34405
BOLTZMANN TRANSPORT EQUATION
See BOLTZMANN EQUATION
BONNEVILLE POWER ADMINISTRATION/INTERCONNECTED POWER SYSTEMS
Revised draft environmental impact statement. The role of the Bonneville Power Administration in the Pacific Northwest power supply system, including its participation in a hydro-thermal power program, 5:33599 (DOE/EIS—0066)
BORANES/TOXICITY
Toxicology of boranes and dichloromethane, 5:34207 (BNL—51118)
BOREHOLES/DEFORMATION
Simulation of a bench scale experiment with an empirical creep law. Technical report, 5:34227 (ONWI—99)
BOREHOLES/DRILLING
Engineering report on the Great Divide Basin drilling project Sweetwater County, Wyoming, May 1980, 5:33301 (GJBX—124(80))
BOREHOLES/STRESS ANALYSIS
Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)

BORN-GREEN-YVON EQUATION
See BOLTZMANN EQUATION
BORON/TOXICITY
Toxicology of boron and boron-containing materials (Results of literature search), 5:34205 (BNL—51118)
BORON 11 REACTIONS/PICKUP REACTIONS
Comparison of the single-proton pickup reactions $^{40}Ca(^{11}B,^{12}C)^{39}K$and $^{40}Ca(^{13}C,^{14}N)^{39}K$at low and high bombarding energies, 5:34326
BORON 11 TARGET/PROTON REACTIONS
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
BORON ALLOYS/MAGNETIC PROPERTIES
Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
BORON CARBIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
BORON COMPOUNDS/TOXICITY
Toxicology of boron and boron-containing materials (Results of literature search), 5:34205 (BNL—51118)
BORON IONS/ION-ATOM COLLISIONS
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
BOUNDARIES (GRAIN)
See GRAIN BOUNDARIES
BREAKERS (CIRCUIT)
See CIRCUIT BREAKERS
BREEDING BLANKETS/DESIGN
Tokamak blanket design study, final report, 5:34413 (ORNL/TM—7049)
BREEDING BLANKETS/RADIOACTIVITY
Safety and personnel access aspects of low activation fusion blankets, 5:34418 (CONF-801011—1)
BRIDGES (ELECTRIC)
See ELECTRIC BRIDGES
BRINES/BIOLOGICAL EFFECTS
Response of confined aquatic biota to mine depressurization water in Beaver Creek Reservoir, 5:34202 (NP—25070)
BRINES/CHEMICAL COMPOSITION
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
BRINES/CORROSIVE EFFECTS
Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
BRINES/FLUID MECHANICS
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
BROMINE/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
BROMINE/CHEMICAL REACTIONS
Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932
BROOKHAVEN NATIONAL LABORATORY
See BNL
BUBBLE CHAMBERS
End of bubble chamber era, 5:34096
BUCKLING (STRUCTURAL)
See DEFORMATION
BUILDING CODES/STANDARDS
Energy conservation standards for new nonresidential buildings, 5:33784
BUILDING MATERIALS
See also ADOBE
CEMENTS
BUILDING MATERIALS/STANDARDS
Criteria for retrofit materials and products for weatherization of residences, 5:33781 (NBS-TN—982)
BUILDINGS
See also ANIMAL SHELTERS
APARTMENT BUILDINGS
COMMERCIAL BUILDINGS
GREENHOUSES
HOSPITALS
HOUSES
OFFICE BUILDINGS
PUBLIC BUILDINGS
RESIDENTIAL BUILDINGS
SCHOOL BUILDINGS
BUILDINGS/AIR CONDITIONING
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
BUILDINGS/DISTRICT HEATING
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
BUILDINGS/DYNAMICS
Dynamic behavior of LLNL buildings during aftershocks of the January 24, 1980 Greenville earthquake, 5:34222 (UCRL—52969)
BUILDINGS/ENERGY ANALYSIS
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2: BDL summary, Version 2.1, 5:33764 (LBL—8688(Rev.1))
DOE-2 sample run book. Version 2.1, 5:33763 (LBL—8678(Rev.1))
BUILDINGS/ENERGY CONSERVATION
Conservation and solar: working together, 5:33481 (LA-UR—80-2330)
Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices, 5:33769 (ORNL/Sub—7470/1-V3)
Effect of resource impact factors on energy conservation standards for buildings, 5:33768 (NBS-BSS—114)
Energy conservation opportunities. Volume II, 5:33770
BUILDINGS/ENERGY CONSUMPTION
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2: BDL summary, Version 2.1, 5:33764 (LBL—8688(Rev.1))
BUILDINGS/HEAT RECOVERY EQUIPMENT
Useful heat from waste heat, 5:33799 (NP—24997)
BUILDINGS/HEATING SYSTEMS
Transport and distribution costs of conventional heat-supply systems in the Federal Republic of Germany. Applied Systems Analysis report No. 13, 5:33761 (Juel-Spez—57)
BUILDINGS/MODIFICATIONS
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
BUILDINGS/NATURAL CONVECTION
Natural convective heat transfer through an aperture in passive solar heated buildings, 5:33480 (LA-UR—80-2328)
BUILDINGS/PASSIVE SOLAR COOLING SYSTEMS
Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
BUILDINGS/PASSIVE SOLAR HEATING SYSTEMS
Conservation and solar: working together, 5:33481 (LA-UR—80-2330)
Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
BUILDINGS/SOLAR AIR CONDITIONING
Solar systems for heating and cooling, 5:33489
BUILDINGS/SOLAR SPACE HEATING
Solar systems for heating and cooling, 5:33489
BUILDINGS/SOLAR WATER HEATING
Solar systems for heating and cooling, 5:33489
BUILDINGS/SPACE HEATING
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
BUILDINGS/WALLS
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
BUILDINGS/WATER HEATERS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
BUNKER OILS
See RESIDUAL FUELS
BUSES/ENERGY CONSERVATION
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
BUSES/ENVIRONMENTAL IMPACTS
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
BUSES/FUEL SUBSTITUTION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
BUTANE/CATALYTIC REFORMING
Process for the simultaneous production of aromatic hydrocarbons and isobutane (Patent), 5:33262
BUTANOLS/PHYSICAL PROPERTIES
Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—)
BUTYL ALCOHOLS
See BUTANOLS
BUTYRIC ALCOHOLS
See BUTANOLS
BWR TYPE REACTORS/FUEL CYCLE
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)

BWR TYPE REACTORS/PHYSICAL PROTECTION DEVICES
Design concepts to enhance nuclear power plant protection, 5:33612 (SAND—80-1428C)
BWR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow, 5:33611 (DOE/ET/34209—T1)
BWR TYPE REACTORS/REACTOR ACCIDENTS
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
BWR TYPE REACTORS/REACTOR CORES
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
BWR TYPE REACTORS/REACTOR INSTRUMENTATION
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
BWR TYPE REACTORS/TEST FACILITIES
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)

C

CADMIUM/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
CADMIUM/TOXICITY
Cadmium toxicity and its relationship to other metals, 5:34209 (BNL—51118)
Carcinogenic, mutagenic, and teratogenic effects of cadmium and arsenic, 5:34215 (BNL—51118)
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
CADMIUM/UPTAKE
Cadmium and arsenic in the environment, 5:34203 (BNL—51118)
CADMIUM SELENIDES/HOT PRESSING
Development of ferromagnetic spinels for optical isolation at 10.6 μm, 5:33912 (DOE/DP/40050—9)
CADMIUM SULFIDE SOLAR CELLS/HEALTH HAZARDS
Photon Power's sprayed cadmium sulfide/cuprous sulfide photovoltaic solar cells, 5:33398 (BNL—51118)
CADMIUM SULFIDE SOLAR CELLS/PRODUCTION
Cadmium sulfide cells, 5:33400 (BNL—51118)
Photon Power's sprayed cadmium sulfide/cuprous sulfide photovoltaic solar cells, 5:33398 (BNL—51118)
CADMIUM SULFIDE SOLAR CELLS/TECHNOLOGY ASSESSMENT
Cadmium sulfide, 5:33394 (BNL—51118)
CADMIUM SULFIDES/HOT PRESSING
Development of ferromagnetic spinels for optical isolation at 10.6 μm, 5:33912 (DOE/DP/40050—9)
CADMIUM SULFIDES/OCCUPATIONAL SAFETY
Cadmium sulfide cells, 5:33400 (BNL—51118)
CADMIUM-AIR BATTERIES/DESIGN
Air battery and electrochemical method (Patent), 5:33645
CAES
See COMPRESSED AIR ENERGY STORAGE
CALCITE/ISOTOPE RATIO
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
CALCIUM/INTERATOMIC FORCES
Valence bond diatomics-in-molecules (DIM) treatment of collinear interactions of Group IIa and IIb metal atoms with hydrogen halides: Application to the CaHCl system, 5:34239
CALCIUM 40 REACTIONS
Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361
CALCIUM 40 REACTIONS/ELASTIC SCATTERING
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM 40 REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM 40 TARGET/ALPHA REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM 40 TARGET/BORON 11 REACTIONS
Comparison of the single-proton pickup reactions $^{40}Ca(^{11}B,^{12}C)^{39}K$ and $^{40}Ca(^{13}C,^{14}N)^{39}K$ at low and high bombarding energies, 5:34326
CALCIUM 40 TARGET/CALCIUM 40 REACTIONS
Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM 40 TARGET/CARBON 13 REACTIONS
Comparison of the single-proton pickup reactions $^{40}Ca(^{11}B,^{12}C)^{39}K$ and $^{40}Ca(^{13}C,^{14}N)^{39}K$ at low and high bombarding energies, 5:34326
CALCIUM 40 TARGET/DEUTERON REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM 40 TARGET/HELIUM 3 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CALCIUM CHLORIDES/LATENT HEAT STORAGE
Study of two passive solar systems containing phase change materials for thermal storage, 5:33475 (LA-UR—80-1669)
CALCIUM COMPOUNDS/CREEP
Creep of 90+ % Al_2O_3 refractory concrete, 5:33904
CALCIUM ISOTOPES/ISOTOPE SEPARATION
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
CALIFORNIA/BUILDING CODES
Energy conservation standards for new nonresidential buildings, 5:33784
CALIFORNIA/COMMERCIAL SECTOR
Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification, 5:33713 (P—300-80-007)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures, 5:33714 (P—300-80-008)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects, 5:33716 (P—300-80-010)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects, 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume V. Review of secondary data, 5:33718 (P—300-80-012)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VI. Establishent characteristics, 5:33719 (P—300-80-013)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VII. Detailed survey, sampling methodology, 5:33720 (P—300-80-014)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VIII. Detailed establishment questionnaire, 5:33721 (P—300-80-015)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IX. Tabulated data collected (computer magnetic tape), 5:33722 (P—300-80-016)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection, 5:33723 (P—300-80-017)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification, 5:33724 (P—300-80-018)
CALIFORNIA/DATA PROCESSING
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures, 5:33714 (P—300-80-008)
CALIFORNIA/ELECTRIC POWER
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
Environmental implications of electric-utility supply plans, 1978-2000, 5:33738 (P—300-80-005)
Proposed electric power projects, 5:33737 (P—300-80-001)
CALIFORNIA/ELECTRIC UTILITIES
Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
Proceedings of the load-management customer-participation workshop, 5:33729
CALIFORNIA/ENERGY POLICY
Panel reports of the first session of the workshop on coal for California, 5:33241 (DOE/ET/12276—T1)
CALIFORNIA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
CALIFORNIA/METEOROLOGY
Long path optical extinction and meteorology in the San Francisco Bay Area, 5:34133 (UCRL—84339)

CALIFORNIA/POLLUTION REGULATIONS
Environmental control technologies for a northern California coal-fired power plant, 5:33597 (P—300-80-002)
CALIFORNIA/POWER PLANTS
Principal electric facilities: Arizona, California, Nevada, 5:33711 (DOE/EIA—0057/9(79))
CALIFORNIA/PUBLIC OPINION
Panel reports of the first session of the workshop on coal for California, 5:33241 (DOE/ET/12276—T1)
CALIFORNIA/TAX LAWS
Regulations for the California Solar Energy Tax Credit, 5:33388 (P—500-79-016)
CALIFORNIA/TECHNOLOGY ASSESSMENT
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
CALIFORNIA/THERMAL POWER PLANTS
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
CALIFORNIUM 250/ENERGY LEVELS
Low-spin states of ^{250}Cf populated in the electron capture decay of 2.22-h ^{250}Es, 5:34345
CALORIMETERS (PARTICLE)
See SHOWER COUNTERS
CAMPHENE/CHEMISTRY
Reviews of the environmental effects of pollutants. X. Toxaphene, 5:34199 (ORNL/EIS—130)
CAMPHENE/ENVIRONMENTAL EFFECTS
Reviews of the environmental effects of pollutants. X. Toxaphene, 5:34199 (ORNL/EIS—130)
CAMPHENE/TOXICITY
Reviews of the environmental effects of pollutants. X. Toxaphene, 5:34199 (ORNL/EIS—130)
CANCER
See NEOPLASMS
CANONICAL EQUATIONS
See DIFFERENTIAL EQUATIONS
CAPACITORS/DIELECTRIC PROPERTIES
Characterization of internal boundary layer capacitors, 5:34368 (DOE/ER/01198—1311)
CAPITALIZED COST/ALLOCATIONS
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
CARBOHYDRATES/COMBUSTION
Minimally refined biomass fuels: an economic shortcut, 5:33432 (UCRL—84136)
CARBON
See also ACTIVATED CARBON
DIAMONDS
CARBON/DEPOSITION
Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
CARBON/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
CARBON 12/GIANT RESONANCE
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
CARBON 12 REACTIONS/ELASTIC SCATTERING
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 TARGET/ALPHA REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 TARGET/CARBON 12 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 TARGET/DEUTERON REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 TARGET/HELIUM 3 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
CARBON 12 TARGET/NITROGEN 15 REACTIONS
Nonstatistical effects in the $^{12}C(^{15}N,\alpha)$ reaction, 5:34322
CARBON 12 TARGET/PION MINUS REACTIONS
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
CARBON 12 TARGET/PION PLUS REACTIONS
Isospin quintets in the 1p and s-d shells, 5:34318
CARBON 12 TARGET/PROTON REACTIONS
Polarization transfer in inelastic scattering, 5:34319 (LA-UR—80-2427)
CARBON 13 REACTIONS/PICKUP REACTIONS
Comparison of the single-proton pickup reactions $^{40}Ca(^{11}B,^{12}C)^{39}K$ and $^{40}Ca(^{13}C,^{14}N)^{39}K$ at low and high bombarding energies, 5:34326
CARBON 14/SCINTILLATION COUNTING
Evaluation of oxidation techniques for preparing bioassay and environmental samples for liquid scintillation counting, 5:34153 (UCRL—52966)
CARBON 14 TARGET/LITHIUM 6 REACTIONS
Gamow-Teller sum rules and the $^{14}C(^{6}Li,^{6}He)^{14}N$ reaction, 5:34323
CARBON DIOXIDE/ENVIRONMENTAL IMPACTS
Climate effects workshop, 5:34134 (UCRL—84677)
CARBON DIOXIDE/PHOTOCHEMISTRY
Photolytic process for gasification of carbonaceous material (Patent), 5:33178
CARBON DIOXIDE/REDUCTION
Photolytic process for gasification of carbonaceous material (Patent), 5:33178
CARBON DIOXIDE/REMOVAL
High CO_2-high H_2S removal with SELEXOL solvent, 5:33282
CARBON IONS/ION-ATOM COLLISIONS
Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment (1 MeV/amu), 5:34258
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
CARBON MONOXIDE/ADSORPTION
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
CARBON MONOXIDE/AIR POLLUTION CONTROL
Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)
CARBON MONOXIDE/CHEMICAL PREPARATION
Photolytic process for gasification of carbonaceous material (Patent), 5:33178
CARBON MONOXIDE/CHEMISORPTION
Further studies of Ni (001)c(2 x 2)CO: Evidence for back donation in the chemisorption bond, 5:33879
CARBON MONOXIDE/ELECTRON COLLISIONS
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
CARBON STEELS/COMPARATIVE EVALUATIONS
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
CARBON STEELS/CORROSION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
CARBONATES/ISOTOPE RATIO
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
CARCINOGENESIS/BIOLOGICAL MODELS
Cell culture systems to study glial transformation, 5:34178 (UCLA—12-1261)
CARCINOGENS/RISK ASSESSMENT
Carcinogens, 5:34212 (BNL—51118)
CARDIOVASCULAR SYSTEM/NUCLEAR MEDICINE
Cardiovascular nuclear medicine 1980, 5:34175 (UCLA—12-1257)
CARPOOLING/ENERGY CONSERVATION
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
CARPOOLING/ENVIRONMENTAL IMPACTS
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
CAT SCANNING/RISK ASSESSMENT
Estimating the risk associated with computerized tomography doses, 5:34185 (CONF-791103—81)
CATALYSTS/CHEMICAL PREPARATION
Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. Second quarterly progress report, January 1-March 31, 1980, 5:33361 (DOE/ET/14858—2)
Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191
CATALYSTS/DEACTIVATION
Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
Development of a simulated catalyst aging technique, 5:33264
CATALYSTS/PERFORMANCE TESTING
Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980, 5:33183 (DOE/ET/14815—12)
Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. Second quarterly progress report, January 1-March 31, 1980, 5:33361 (DOE/ET/14858—2)
Development of a simulated catalyst aging technique, 5:33264
Erection and operation of a Fischer-Tropsch-pilot plant with liquid-phase reactor, 5:33197 (BMFT-FB-T—80-033)
CATALYSTS/REGENERATION
Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal, 5:33209

CATALYSTS/SPECIFICITY
CO hydrogenation over rhodium foil and single crystal catalysts: correlations of catalyst activity, selectivity, and surface composition, 5:33203
Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. Second quarterly progress report, January 1-March 31, 1980, 5:33361 (DOE/ET/14858—2)
Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191
CATALYTIC COMBUSTORS/DESIGN
Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)
CATALYTIC COMBUSTORS/PERFORMANCE
Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)
CATALYTIC CRACKING
See also HYDROCRACKING
CATALYTIC CRACKING/CATALYSTS
Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix (Patent), 5:33260
Hydrocarbon cracking catalyst (Patent), 5:33255
CATHODES/DESIGN
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
CATION EXCHANGE CAPACITY
See CATIONS
CATIONS/ION EXCHANGE
Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)
CAVITY RESONATORS
See also SUPERCONDUCTING CAVITY RESONATORS
CAVITY RESONATORS/ENERGY ABSORPTION
Preliminary simulation studies of accelerator cavity loading, 5:34072 (LA—8405-MS)
CAVITY RESONATORS/MAGNETRONS
Relativistic electron beam crossed-field device (Patent), 5:34242
CDC COMPUTERS/TRANSLATORS
BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition, 5:34447 (LBL—10189/1)
CELLS (ANIMAL)
See ANIMAL CELLS
CELLS (ELECTROLYTIC)
See ELECTROLYTIC CELLS
CEMENTS
See also GYPSUM CEMENTS
CEMENTS/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
CENTAURO-TYPE EVENTS/LECTURES
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
CENTRIFUGES
See also GAS CENTRIFUGES
CENTRIFUGES/TEST FACILITIES
Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities, 5:33949 (SAND—80-0481)
CERAMICS/COMPARATIVE EVALUATIONS
Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes, 5:33316 (DOE/TIC—11219)
CERAMICS/DIELECTRIC PROPERTIES
Characterization of internal boundary layer capacitors, 5:34368 (DOE/ER/01198—1311)
CERAMICS/MATERIALS TESTING
High temperature fuel cell research and development. Final technical status report, 1 March 1979-31 March 1980 (Molten carbonate fuel cells), 5:33755 (DOE/ET/11320—T1)
CERAMICS/PHYSICAL PROPERTIES
Regenerator matrix physical property data, 5:33821 (DOE/NASA/0008—80/11)
CERAMICS/STABILITY
Regenerator matrix physical property data, 5:33821 (DOE/NASA/0008—80/11)
CERAMICS/ULTRASONIC TESTING
Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
CEREALS
See also MAIZE
SORGHUM
CEREALS/DRYING
Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
CERIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
CERN ISR
(28-GeV proton--proton storage ring at Geneva.)
CERN ISR/SHOWER COUNTERS
Uranium scintillator calorimeter at the CERN ISR, 5:34080 (BNL—28214)
CERRO PRIETO GEOTHERMAL FIELD/GEOLOGIC STRUCTURES
Subsurface geological and geophysical study of the Cerro Prieto geothermal field, 5:33554 (LBL—10540)
CERRO PRIETO GEOTHERMAL FIELD/HYDROTHERMAL ALTERATION
Subsurface geological and geophysical study of the Cerro Prieto geothermal field, 5:33554 (LBL—10540)
CERRO PRIETO GEOTHERMAL FIELD/STRATIGRAPHY
Subsurface geological and geophysical study of the Cerro Prieto geothermal field, 5:33554 (LBL—10540)
CESIUM/MASS SPECTROSCOPY
Direct determination of cesium in pilot plant effluents by isotope dilution mass spectrometry, 5:33925 (DP-MS—80-17)
CESIUM/UPTAKE
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
CESIUM 137/USES
Irradiation of sewage sludge using cesium-137: a comparative assessment, 5:33348 (SAND—80-7097)
CHARM PARTICLES/LECTURES
From the psi to charm: The experiments of 1975 and 1976 (Nobel prize lecture), 5:34278
CHARMONIUM/LECTURES
From the psi to charm: The experiments of 1975 and 1976 (Nobel prize lecture), 5:34278
CHARS/CATALYSTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
CHARS/GASIFICATION
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
CHATTANOOGA FORMATION/GAMMA LOGGING
Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee, 5:33288 (DOE/METC/10866—18)
CHATTANOOGA FORMATION/GEOLOGICAL SURVEYS
Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee, 5:33288 (DOE/METC/10866—18)
CHATTANOOGA FORMATION/THICKNESS
Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee, 5:33288 (DOE/METC/10866—18)
CHELATES/BONDING
Cathode catalyst for primary phosphoric acid fuel cells. Fourth quarterly report, April-June, 1980, 5:33756 (DOE/NASA/0150—80/4)
CHEMICAL EFFLUENTS/CHEMICAL ANALYSIS
Effects of coal structure and processing conditions on organic effluents from slagging fixed-bed gasification, 5:33193
CHEMICAL EFFLUENTS/ENVIRONMENTAL IMPACTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
CHEMICAL EFFLUENTS/FRACTIONATION
Effects of coal structure and processing conditions on organic effluents from slagging fixed-bed gasification, 5:33193
CHEMICAL EFFLUENTS/HEALTH HAZARDS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
CHEMICAL EXPLOSIVES/DETONATORS
Deflagration-to-detonation transition project: quarterly report for the period September through November 1979, 5:34103 (SAND—80-1157)
CHEMICAL EXPLOSIVES/IMPACT SHOCK
Temperature measurements of shocked energetic materials by time-resolved infrared radiometry, 5:34106 (UCRL—84587)
CHEMICAL EXPLOSIVES/PERFORMANCE TESTING
Sensitivity experiments: a one-shot experimental design and the ASENT computer program, 5:34104 (SAND—80-8216)
CHEMICAL EXPLOSIVES/SENSITIVITY
Sensitivity experiments: a one-shot experimental design and the ASENT computer program, 5:34104 (SAND—80-8216)
CHEMICAL EXPLOSIVES/STORAGE FACILITIES
Design of a maze structure to attenuate blast waves, 5:34105 (UCRL—52921)
CHEMICAL EXPLOSIVES/TEMPERATURE MEASUREMENT
Temperature measurements of shocked energetic materials by time-resolved infrared radiometry, 5:34106 (UCRL—84587)

CHEMICAL HEAT PUMPS
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
CHEMICAL REACTIONS
See also DESULFURIZATION
FISCHER-TROPSCH SYNTHESIS
HYDRIDATION
HYDROGENATION
METHANATION
PHOTOCHEMICAL REACTIONS
PHOTOSYNTHESIS
CHEMICAL REACTIONS/CATALYSTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
CHEMICAL REACTORS/DESIGN
Applied Fischer-Tropsch kinetics for a flame sprayed iron catalyst, 5:33181
CHEMICAL REACTORS/TEMPERATURE CONTROL
Applied Fischer-Tropsch kinetics for a flame sprayed iron catalyst, 5:33181
CHEMICAL SPILLS/MATHEMATICAL MODELS
Sulfuric acid spills in marine accidents, 5:34161 (BNL—28123)
CHEMISTRY
See also COSMOCHEMISTRY
GEOCHEMISTRY
RADIATION CHEMISTRY
CHEMISTRY/RESEARCH PROGRAMS
Chemical Sciences Division, 5:33922 (BNL—50973)
CHINA/GEOTHERMAL EXPLORATION
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
Present state, future prospects of geothermal exploration reviewed, 5:33558 (JPRS—75887)
CHINA/OIL FIELDS
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
CHINA/PETROLEUM GEOLOGY
Characteristics of evolution of petroleum in Huanghua Depression, 5:33242 (JPRS—75887)
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
CHINESE BEAN OIL
See SOYBEAN OIL
CHIRAL SYMMETRY/SYMMETRY BREAKING
Chiral-symmetry breakdown in large-N chromodynamics, 5:34298
CHLORINATED ALIPHATIC HYDROCARBONS
See also CHLOROFORM
CHLORINATED ALIPHATIC HYDROCARBONS/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
CHLORINATED ALIPHATIC HYDROCARBONS/TOXICITY
Toxicology of boranes and dichloromethane, 5:34207 (BNL—51118)
CHLORINE/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
CHLORINE/CHEMICAL REACTIONS
Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932
CHLORITE MINERALS/ABUNDANCE
Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
CHLOROFORM/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
CHLOROPHYLL/ELECTRON TRANSFER
Picosecond electron transfer in diporphyrin models of Photosystem II of green plants, 5:34167 (BNL—28030)
CHROMIUM/CATALYTIC EFFECTS
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
CHROMIUM/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
CHROMIUM/SURFACE COATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
CHROMIUM 51/BIOLOGICAL HALF-LIFE
Improved methods for measuring radioactive tracer accumulation and excretion by microarthropods, with applications for a mite species, Tyrophagus longior (Acarina, Acaridae), 5:34171 (DOE/EV/00641—38)
CHROMIUM ALLOYS
See also CHROMIUM STEELS
CHROMIUM ALLOYS/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
CHROMIUM ALLOYS/MECHANICAL PROPERTIES
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
CHROMIUM ALLOYS/MICROSTRUCTURE
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
CHROMIUM ALLOYS/OXIDATION
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
CHROMIUM ALLOYS/PHYSICAL RADIATION EFFECTS
Gamma prime hardened nickel-iron based superalloy (Patent), 5:33889
CHROMIUM ALLOYS/SURFACE PROPERTIES
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
CHROMIUM OXIDES/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
CHROMIUM OXIDES/REDOX REACTIONS
Redox reactions involving chromium, plutonium, and manganese in soils, 5:34150 (DOE/DP/04515—1)
CHROMIUM SELENIDES/HOT PRESSING
Development of ferromagnetic spinels for optical isolation at 10.6 μm, 5:33912 (DOE/DP/40050—9)
CHROMIUM STEELS
(Steels containing only chromium as alloying element; see also CHROMIUM-NICKEL STEELS.)
CHROMIUM STEELS/MICROSTRUCTURE
Sliding wear, toughness and microstructural relationships in high strength Fe/Cr/C experimental steels, 5:33854 (LBL—10994)
CHROMIUM STEELS/WEAR RESISTANCE
Sliding wear, toughness and microstructural relationships in high strength Fe/Cr/C experimental steels, 5:33854 (LBL—10994)
CHROMIUM SULFATES/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
CHROMIUM SULFATES/EQUILIBRIUM
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
CHROMIUM SULFIDES/HOT PRESSING
Development of ferromagnetic spinels for optical isolation at 10.6 μm, 5:33912 (DOE/DP/40050—9)
CHROMIUM-MOLYBDENUM STEELS/CORROSION
Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
CHROMIUM-MOLYBDENUM STEELS/CRACKS
Influences of gaseous environment on low growth-rate fatigue crack propagation in steels. Annual report No. 1, January 1980. Report No. FPL/R/80/1030, 5:33858 (DOE/ER/10389—1)
CHROMIUM-MOLYBDENUM STEELS/DECARBURIZATION
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
CHROMIUM-MOLYBDENUM STEELS/EMBRITTLEMENT
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 6, November 15, 1979-February 15, 1980, 5:33860 (DOE/ET/13513—T2)
CHROMIUM-MOLYBDENUM STEELS/HYDROGEN EMBRITTLEMENT
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 6, November 15, 1979-February 15, 1980, 5:33860 (DOE/ET/13513—T2)
Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement, 5:33859 (DOE/ET/13513—T1)
CHROMIUM-MOLYBDENUM STEELS/TENSILE PROPERTIES
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
CHROMODYNAMICS
See QUANTUM CHROMODYNAMICS
CIRCUIT BREAKERS/DESIGN
Fundamental investigation of arc interruption in gas flows. Final report, 5:33600 (EPRI-EL—1455)
CIRCUIT BREAKERS/OPERATION
Fundamental investigation of arc interruption in gas flows. Final report, 5:33600 (EPRI-EL—1455)
CIRCULAR POINT COLLECTORS
See PARABOLIC DISH COLLECTORS
CLAMS
See MOLLUSCS
CLAYS
See also ILLITE
MONTMORILLONITE
CLAYS/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)

CLINTON P ANDERSON MESON PHY. FACILITY
See LAMPF LINAC
CLOSED-CYCLE COOLING SYSTEMS/BIBLIOGRAPHIES
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
CLOSED-CYCLE COOLING SYSTEMS/ENVIRONMENTAL IMPACTS
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
CLOSURES/DESIGN
Retrievable plug for offshore platforms (Patent), 5:34025
COAL
See also ANTHRACITE
BITUMINOUS COAL
LIGNITE
COAL/CALORIFIC VALUE
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
COAL/CHEMICAL COMPOSITION
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
Influence of coal mineral matter on slagging of utility boilers. Final report, 5:33587 (EPRI-CS—1418)
COAL/COKING
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
COAL/COMBUSTION PRODUCTS
Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
COAL/COMMINUTION
Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
COAL/DECOMPOSITION
Low temperature chemical fragmentation of coal, 5:33199 (DOE/ET/13381—T1)
COAL/DEPOLYMERIZATION
Chemical characterization of a hvb coal, 5:33217
COAL/DESULFURIZATION
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
Photolytic process for gasification of carbonaceous material (Patent), 5:33178
Process Sciences Division, 5:33574 (BNL—50973)
Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
COAL/EXPORTS
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
COAL/EXTRUSION
Model for the isothermal plastometric behavior of coals, 5:33216
COAL/FLUIDIZED-BED COMBUSTION
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
Industrial application fluidized bed combustion. Category III: indirect fired heaters. Quarterly technical report No. 14, October 1-December 31, 1979, 5:34065 (FE—2471-45)
Technical planning study: Pressurized Fluidized-Bed Combustion. Final report, 5:33238 (EPRI-CS—1465)
COAL/HYDROCRACKING
Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal, 5:33209
COAL/HYDROGENATION
Pyrolysis and hydrogenation process (Patent), 5:33180
COAL/MEETINGS
Panel reports of the first session of the workshop on coal for California, 5:33241 (DOE/ET/12276—T1)
COAL/ORGANIC WASTES
Laboratory evaluation of an N_2 laser fluorosensor, 5:34098 (EGG—1183-2369)
COAL/PETROLOGY
Structural characteristics of vitrinites, 5:33218
COAL/PLASTICITY
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
Model for the isothermal plastometric behavior of coals, 5:33216
COAL/PRICES
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
COAL/PRODUCTION
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
COAL/PYROLYSIS
Process Sciences Division, 5:33574 (BNL—50973)
Pyrolysis and hydrogenation process (Patent), 5:33180
Rates of light gas production by devolatilization of coals and lignite, 5:33211
Thermal decomposition of aromatic substances, 5:33212
COAL/RESEARCH PROGRAMS
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
COAL/SOLVENT EXTRACTION
Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
COAL/STRUCTURAL CHEMICAL ANALYSIS
Aliphatic components of coal. Quarterly report, March-June 1980, 5:33200 (DOE/ET/13381—T2)
Chemical characterization of a hvb coal, 5:33217
Low temperature chemical fragmentation of coal, 5:33199 (DOE/ET/13381—T1)
Structural characteristics of vitrinites, 5:33218
COAL/TRADE
International energy indicators, 5:33663 (DOE/IA—0010/2)
COAL/TRANSPORT
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
COAL GASIFICATION
See also COGAS PROCESS
FLASH HYDROPYROLYSIS PROCESS
TRI-GAS PROCESS
Photolytic process for gasification of carbonaceous material (Patent), 5:33178
Pyrolysis and hydrogenation process (Patent), 5:33180
COAL GASIFICATION/CATALYSTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
COAL GASIFICATION/CHEMICAL EFFLUENTS
Effects of coal structure and processing conditions on organic effluents from slagging fixed-bed gasification, 5:33193
COAL GASIFICATION/ELECTROCHEMISTRY
Electrochemical route to coal gasification and its technological implications, 5:33195
COAL GASIFICATION/ENVIRONMENTAL IMPACTS
Low Btu gasifier emissions toxicology program. Status report October 1979, 5:34198 (LMF—75)
COAL GASIFICATION/MEETINGS
Coal gasification chemistry. Flash hydrogenation reactions of coal. Pyrolysis reactions of coal. Government role in fuels R & D. Henry H. Storch award symposium, 5:33192
COAL GASIFICATION/PROCESS DEVELOPMENT UNITS
Advanced development of a short-residence-time hydrogasifier. Quarterly technical progress report, April 1, 1980-June 30, 1980, 5:33187 (FE—3125-21)
COAL GASIFICATION PLANTS/CAPITAL
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
COAL GASIFICATION PLANTS/DESIGN
Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant, 5:33189 (FE—2012-096(Sect.1)(Exec.Summ.))
COAL GASIFICATION PLANTS/DIAGRAMS
Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant (No text), 5:33185 (FE—2012-096(App.))
COAL GASIFICATION PLANTS/ENGINEERING
Pipeline Gas Demonstration Plant. Phase I. Process evaluation report, conceptual commercial plant, 5:33186 (FE—2012-096(Sect.4))
Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant (No text), 5:33185 (FE—2012-096(App.))
Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant, 5:33189 (FE—2012-096(Sect.1)(Exec.Summ.))
COAL GASIFICATION PLANTS/ENVIRONMENTAL EFFECTS
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174

COAL GASIFICATION PLANTS/EVALUATION
Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant, 5:33189 (FE—2012-096(Sect.1)(Exec.Summ.))
COAL GASIFICATION PLANTS/FINANCING
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
COAL GASIFICATION PLANTS/MATERIALS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
COAL GASIFICATION PLANTS/MATERIALS TESTING
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
COAL GASIFICATION PLANTS/OCCUPATIONAL SAFETY
Use of a fiber-optics skin contamination monitor in the workplace, 5:33240 (CONF-800814—13)
COAL GASIFICATION PLANTS/PERSONNEL MONITORING
Use of a fiber-optics skin contamination monitor in the workplace, 5:33240 (CONF-800814—13)
COAL GASIFICATION PLANTS/POLLUTION CONTROL
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
COAL GASIFICATION PLANTS/SOLID WASTES
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
COAL GASIFICATION PLANTS/SPECIFICATIONS
Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant (No text), 5:33185 (FE—2012-096(App.))
COAL GASIFICATION PLANTS/THERMAL EFFICIENCY
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
COAL GASIFICATION PLANTS/VALVES
Rockwell Coal Lock Hopper Valve: METC SOA Test Valve No. A-16. State-of-the-art Lock Hopper Valve Testing and Development Project. Summary test report, 5:33184 (DOE/METC/SP—80/8)
COAL GASIFICATION PLANTS/WASTE WATER
Biological treatment of Grand Forks Energy Technology Center slagging fixed-bed coal gasification process wastewater. Eleventh quarterly report, March 1979, 5:33220 (FE—2496-42)
COAL INDUSTRY
See also MINERAL INDUSTRY
COAL INDUSTRY/EMPLOYMENT
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
COAL INDUSTRY/LABOR RELATIONS
Labor outlook for the bituminous coal mining industry. Final report (Forecasting to 1990 and 2030), 5:33706 (EPRI-EA—1477)
COAL INDUSTRY/MANPOWER
Labor outlook for the bituminous coal mining industry. Final report (Forecasting to 1990 and 2030), 5:33706 (EPRI-EA—1477)
COAL INDUSTRY/PRODUCTIVITY
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
Labor outlook for the bituminous coal mining industry. Final report (Forecasting to 1990 and 2030), 5:33706 (EPRI-EA—1477)
COAL LIQUEFACTION
See also FLASH HYDROPYROLYSIS PROCESS
SRC-II PROCESS
Pyrolysis and hydrogenation process (Patent), 5:33180
COAL LIQUEFACTION/CATALYSTS
Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202
COAL LIQUEFACTION/CHEMICAL REACTION KINETICS
Chemical Sciences Division, 5:33922 (BNL—50973)
COAL LIQUEFACTION/CHEMICAL REACTIONS
Low temperature reaction path for coal liquefaction, 5:33207
COAL LIQUEFACTION/CHEMISTRY
Aliphatic components of coal. Quarterly report, March-June 1980, 5:33200 (DOE/ET/13381—T2)
Low temperature chemical fragmentation of coal, 5:33199 (DOE/ET/13381—T1)
Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202
COAL LIQUEFACTION/HYDROGENATION
Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202
COAL LIQUEFACTION/MEETINGS
Coal gasification chemistry. Flash hydrogenation reactions of coal. Pyrolysis reactions of coal. Government role in fuels R & D. Henry H. Storch award symposium, 5:33192
COAL LIQUEFACTION/ORGANIC SOLVENTS
Effect of solvent quality on coal conversion, 5:33204
COAL LIQUEFACTION/PROCESS DEVELOPMENT UNITS
Products of liquefaction of lignite with synthesis gas by product slurry recycle, 5:33205
COAL LIQUEFACTION/YIELDS
Products of liquefaction of lignite with synthesis gas by product slurry recycle, 5:33205
COAL LIQUEFACTION PLANTS/ENVIRONMENTAL EFFECTS
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
COAL LIQUEFACTION PLANTS/MATERIALS TESTING
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
COAL LIQUEFACTION PLANTS/POLLUTION CONTROL
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
COAL LIQUEFACTION PLANTS/SOLID WASTES
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
COAL LIQUIDS/COMMERCIALIZATION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
COAL LIQUIDS/DESULFURIZATION
Selectivity of coal minerals and SRC residue ashes for hydrodesulfurization in the SRC process, 5:33208
COAL LIQUIDS/FRACTIONATION
Chemical characterization of a hvb coal, 5:33217
COAL LIQUIDS/INFRARED SPECTRA
Characterization of upgraded coal liquids, 5:33206
COAL LIQUIDS/MUTAGEN SCREENING
Exploratory research on mutagenic activity of coal-related materials, 5:34201 (DOE/ET/00222—4)
COAL LIQUIDS/NUCLEAR MAGNETIC RESONANCE
Characterization of upgraded coal liquids, 5:33206
COAL LIQUIDS/PHYSICAL PROPERTIES
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
COAL LIQUIDS/REFINING
Characterization of upgraded coal liquids, 5:33206
COAL LIQUIDS/STRUCTURAL CHEMICAL ANALYSIS
Chemical characterization of a hvb coal, 5:33217
COAL LIQUIDS/THERMODYNAMIC PROPERTIES
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
COAL MINES/ENVIRONMENTAL EFFECTS
Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Draft environmental statement (Draft EIS), 5:33227
Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Final environmental statement (Draft EIS, comments and responses), 5:33228
COAL MINES/PERMIT APPLICATIONS
Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Draft environmental statement (Draft EIS), 5:33227
Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Final environmental statement (Draft EIS, comments and responses), 5:33228
COAL PREPARATION PLANTS/PERFORMANCE TESTING
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979 (South Africa), 5:33172 (NP—25053)
COAL PREPARATION PLANTS/SITE SELECTION
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
COAL-DERIVED LIQUIDS
See COAL LIQUIDS
COASTAL REGIONS/INSOLATION
Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
COATED FUEL PARTICLES/DISSOLUTION
Dissolution of HTGR TRISO beads by the alkali fluoride fusion method, 5:33308 (NBL—296)
COBALT/CATALYTIC EFFECTS
Cobalt-molybdenum-alumina desulfurization catalyst (Patent), 5:33254
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252

COBALT/SURFACE COATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
COBALT ALLOYS
See also COBALT BASE ALLOYS
COBALT ALLOYS/DEHYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
COBALT ALLOYS/HYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
COBALT ALLOYS/MECHANICAL PROPERTIES
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
COBALT ALLOYS/MICROSTRUCTURE
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
COBALT BASE ALLOYS/MAGNETIC PROPERTIES
Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
COBALT BASE ALLOYS/OXIDATION
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
COBALT BASE ALLOYS/SURFACE PROPERTIES
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
COBALT COMPOUNDS/BONDING
Cathode catalyst for primary phosphoric acid fuel cells. Fourth quarterly report, April-June, 1980, 5:33756 (DOE/NASA/0150—80/4)
COGAS PROCESS/DEMONSTRATION PLANTS
Pipeline Gas Demonstration Plant. Phase I. Process evaluation report, conceptual commercial plant, 5:33186 (FE—2012-096(Sect.4))
Pipeline Gas Demonstration Plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant (No text), 5:33185 (FE—2012-096(App.))
Pipeline gas demonstration plant, Phase I. Abbreviated version of Process Evaluation Report, conceptual commercial plant, 5:33189 (FE—2012-096(Sect.1)(Exec.Summ.))
COGENERATION
See CO-GENERATION
CO-GENERATION/ENERGY SOURCES
Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—)
CO-GENERATION/ENVIRONMENTAL IMPACTS
Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—)
CO-GENERATION/FEASIBILITY STUDIES
Feasibility of a large-scale cogeneration/hot-water district-heating system in the Twin Cities, 5:33806 (CONF-790401—)
St. Paul district-heating study, 5:33808 (CONF-790401—)
CO-GENERATION/INSTITUTIONAL FACTORS
Twin Cities institutional issues study: cogenerated hot-water district heating, 5:33807 (CONF-790401—)
CO-GENERATION/MEETINGS
District-heating/cogeneration symposium, 5:33803 (CONF-790401—)
CO-GENERATION/PERFORMANCE
European district-heating experience with focus on Uppsala hot-water district-heating system, 5:33804 (CONF-790401—)
CO-GENERATION/PLANNING
Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—)
CO-GENERATION/RESOURCE ASSESSMENT
Cogeneration of electricity in the St. Louis region: industrial potential, 5:33797 (CUERS-Report—10)
COLLIERIES
See COAL MINES
COLOR MODEL/LECTURES
From the psi to charm: The experiments of 1975 and 1976 (Nobel prize lecture), 5:34278
COLORADO/GEOTHERMAL ENERGY
Regulation of geothermal energy development in Colorado, 5:33566 (DOE/ID/12018—2)
COLORADO/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
COLUMBIA RIVER BASIN/HYDROELECTRIC POWER
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
COLUMBIUM
See NIOBIUM
COMBUSTION
See also FLUIDIZED-BED COMBUSTION
REVERSE COMBUSTION
COMBUSTION/RESEARCH PROGRAMS
Formation and destruction of pollutants in combustion processes: clearing the air on the role of combustion research, 5:34125 (LBL—11237)
COMBUSTION PRODUCTS/AIR POLLUTION CONTROL
Formation and destruction of pollutants in combustion processes: clearing the air on the role of combustion research, 5:34125 (LBL—11237)
COMBUSTION PRODUCTS/CORROSIVE EFFECTS
Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
COMBUSTION PRODUCTS/PURIFICATION
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
COMMERCIAL BUILDINGS/BUILDING CODES
Energy conservation standards for new nonresidential buildings, 5:33784
COMMERCIAL BUILDINGS/DATA ACQUISITION
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IX. Tabulated data collected (computer magnetic tape), 5:33722 (P—300-80-016)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection, 5:33723 (P—300-80-017)
COMMERCIAL BUILDINGS/ENERGY CONSERVATION
Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices, 5:33769 (ORNL/Sub—7470/1-V3)
Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
COMMERCIAL BUILDINGS/ENERGY CONSUMPTION
Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
Uncertainties in our understanding of energy conservation, 5:33774 (CONF-800835—2)
COMMERCIAL BUILDINGS/ENERGY DEMAND
Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16, 5:33777 (Juel-Spez—64)
COMMERCIAL BUILDINGS/POWER DEMAND
Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification, 5:33713 (P—300-80-007)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures, 5:33714 (P—300-80-008)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects, 5:33716 (P—300-80-010)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects, 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume V. Review of secondary data, 5:33718 (P—300-80-012)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VI. Establishent characteristics, 5:33719 (P—300-80-013)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection, 5:33723 (P—300-80-017)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification, 5:33724 (P—300-80-018)
COMMERCIAL BUILDINGS/SOLAR AIR CONDITIONING
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
COMMERCIAL BUILDINGS/SOLAR SPACE HEATING
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)

COMMERCIAL BUILDINGS/SOLAR WATER HEATING
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
COMMERCIAL BUILDINGS/SPACE HEATING
Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16, 5:33777 (Juel-Spez—64)
COMMERCIAL BUILDINGS/SURVEYS
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VI. Establishent characteristics, 5:33719 (P—300-80-013)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VII. Detailed survey, sampling methodology, 5:33720 (P—300-80-014)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume VIII. Detailed establishment questionnaire, 5:33721 (P—300-80-015)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IX. Tabulated data collected (computer magnetic tape) , 5:33722 (P—300-80-016)
COMMERCIAL SECTOR/HEATING OILS
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
COMMERCIAL SECTOR/POWER DEMAND
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
COMMERCIAL SECTOR/REFRIGERATING MACHINERY
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
COMMERCIALIZATION
See also DEMONSTRATION PROGRAMS
TECHNOLOGY UTILIZATION
COMMERCIALIZATION/TECHNOLOGY UTILIZATION
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
COMMUNITIES
See also PLANNED COMMUNITIES
COMMUNITIES/ENERGY CONSERVATION
Energy conserving site design: Greenbrier case study, Chesapeake, Virginia. Final report, 5:33800 (DOE/CS/24216—1)
Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries., 5:33786
COMMUNITIES/PLANNING
Energy conserving site design: Greenbrier case study, Chesapeake, Virginia. Final report, 5:33800 (DOE/CS/24216—1)
COMMUNITIES/TRAFFIC CONTROL
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
COMPATIBILITY (IMMUNOLOGICAL)
See IMMUNITY
COMPOSITE MATERIALS
See also CONCRETE-PLASTIC COMPOSITES
COMPOSITE MATERIALS/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
COMPOSITE MATERIALS/FABRICATION
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
Process Sciences Division, 5:33574 (BNL—50973)
COMPOUND PARABOLIC CONCENTRATORS
See also PARABOLIC REFLECTORS
COMPOUND PARABOLIC CONCENTRATORS/DESIGN
Stationary concentrator for industry, 5:33525
COMPOUNDS (ORGANIC)
See ORGANIC COMPOUNDS
COMPRESSED AIR ENERGY STORAGE/SANDSTONES
Experimental study of the response of the Galesville sandstone to simulated CAES conditions, 5:33635 (PNL—3399)
COMPUTER AXIAL TOMOGRAPHY SCANNING
See CAT SCANNING
COMPUTER CALCULATIONS/ALGORITHMS
Multiple precision integer operation package, 5:34449 (SAND—80-1146)
COMPUTER CODES
Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification (Description of subprograms BEHAV, DEMAND, ECON, ENER, and INGEN), 5:33713 (P—300-80-007)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures (Data requirements for subprograms BEHAV, DEMAND, ECON, ENER, and INGEN), 5:33714 (P—300-80-008)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects (Description of subprograms DEMAND, ENER, and INGEN), 5:33716 (P—300-80-010)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects (Description of subprograms BEHAV and ECON), 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification (Submodels DEMAND, ECON, ENER, and INGEN), 5:33724 (P—300-80-018)
COMPUTER CODES/A CODES
Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices, 5:33769 (ORNL/Sub—7470/1-V3)
Sensitivity experiments: a one-shot experimental design and the ASENT computer program, 5:34104 (SAND—80-8216)
COMPUTER CODES/C CODES
Economic evaluation of the annual cycle energy system (ACES). Final report. Volume III, appendices, 5:33769 (ORNL/Sub—7470/1-V3)
Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles, 5:33802 (ANL/CNSV-TM—40)
COMPUTER CODES/CONVERSION
BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition, 5:34447 (LBL—10189/1)
COMPUTER CODES/D CODES
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2: BDL summary, Version 2.1, 5:33764 (LBL—8688(Rev.1))
DOE-2 sample run book. Version 2.1, 5:33763 (LBL—8678(Rev.1))
COMPUTER CODES/E CODES
Multiple precision integer operation package (EPADD, EPSUB, EPMULT, EPDIVR, ENTQRM, EBDTOB, EPBTOD, EPMDEX, EPCOPY, EPINIT, EPCHK, in FORTRAN for CDC 6600-7600), 5:34449 (SAND—80-1146)
COMPUTER CODES/F CODES
FOUR: a general crystallographic Fourier program (In FORTRAN), 5:34369 (IS—4737)
COMPUTER CODES/G CODES
GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array, 5:34393 (ANL/FPP/TM—135)
COMPUTER CODES/MANUALS
Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide), 5:33561 (DOE/ID/12079—3)
COMPUTER CODES/P CODES
Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide), 5:33561 (DOE/ID/12079—3)
COMPUTER CODES/QUALITY CONTROL
Quality control of software in dissimilar systems using a common clinical data base, 5:34173 (DOE/EV/10343—4)
COMPUTER CODES/S CODES
Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide), 5:33562 (DOE/ID/12079—6)
Modification and implementation of the M.E.T.C. SIMPAC program, 5:33550 (DOE/AL/10563—T5)
Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies, 5:33385 (NP—24996)
SALE: a simplified ALE computer program for fluid flow at all speeds, 5:34443 (LA—8095)
Solar energy design improvement: a methodology for hydronic flat plate collector systems (SOLOAD-1), 5:33512 (AD-A—076836)
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
COMPUTER CODES/W CODES
Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1), 5:33563 (DOE/ID/12079—1)
COMPUTER GRAPHICS
Computer-aided visualization of database structural relationships, 5:34458 (LBL—10437)

COMPUTER LANGUAGES
See PROGRAMMING LANGUAGES
COMPUTER NETWORKS/PERFORMANCE
Simulation study of the configuration dependent performance of a prioritized, CSMA broadcast network, 5:34452 (UCRL—84446)
COMPUTERS
See also CDC COMPUTERS
CRAY COMPUTERS
COMPUTERS/MICROELECTRONIC CIRCUITS
Superconductive electronics in future computer designs, 5:34018
COMPUTERS/PERFORMANCE
Implementing techniques for elliptic problems on vector processors, 5:34446 (LA-UR—80-2343)
COMPUTERS/PROGRAMMING
Implementing techniques for elliptic problems on vector processors, 5:34446 (LA-UR—80-2343)
User guide for transferring data from NOS (Network Operating System) to Applicon Graphics System, 5:34448 (SAND—80-1124)
COMPUTERS/RESEARCH PROGRAMS
Development and application of data flow computers. Final report, January 17, 1978-September 30, 1979 (Lab. for Computer Science, Massachusetts Inst. of Tech.), 5:34451 (UCRL—15258)
CONCENTRATING COLLECTORS
See also PARABOLIC COLLECTORS
CONCENTRATING COLLECTORS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
CONCENTRATING COLLECTORS/DESIGN
First-order design variables for concentrating solar collectors, 5:33527
CONCENTRATING COLLECTORS/PERFORMANCE
Comparison of solar thermal energy collection using fixed and tracking collectors, 5:33532
First-order design variables for concentrating solar collectors, 5:33527
CONCENTRATOR SOLAR CELLS/RESEARCH PROGRAMS
Systems development activities and photovoltaic concentrator technology, 5:33442 (BNL—51118)
CONCRETE-PLASTIC COMPOSITES/FABRICATION
Process Sciences Division, 5:33574 (BNL—50973)
CONDENSATION (VAPOR)
See VAPOR CONDENSATION
CONDENSED AROMATICS/STRUCTURAL CHEMICAL ANALYSIS
Cyano-arenes produced by combustion of nitrogen-containing fuels, 5:33175
CONNECTICUT/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
CONNECTICUT/TRANSPORTATION SECTOR
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
CONSERVATION (ENERGY)
See ENERGY CONSERVATION
CONTAINERS
See also PRESSURE VESSELS
CONTAINERS/MATERIALS
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
CONTAINERS/SERVICE LIFE
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
CONTAINMENT SYSTEMS/PERFORMANCE
Tritium practices past and present, 5:34023 (UCRL—84318)
CONTAMINATION (INTERNAL)
See RADIONUCLIDE KINETICS
CONTINENTAL SHELF/BOUNDARY LAYERS
Benthic boundary-layer velocity profiles: Dependence on averaging period, 5:34232
CONTINENTAL SHELF/NATURAL GAS DEPOSITS
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
CONTINENTAL SHELF/PETROLEUM DEPOSITS
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
CONVECTION
(Heat transfer by convection.)
CONVECTION/SCATTERING
Combined radiation convection in thermally developing Poiseuille flow with scattering, 5:34037
COOLERS
See HEAT EXCHANGERS
COOLING PONDS/THERMAL POLLUTION
Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report, 5:34195 (EPRI-EA—1148(Vol.1))
COOLING SYSTEMS
See also CLOSED-CYCLE COOLING SYSTEMS
COOLING SYSTEMS/ECONOMIC ANALYSIS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
COOLING SYSTEMS/ENERGY STORAGE
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)
COOLING SYSTEMS/EVAPORATIVE COOLING
Unit thermal performance of atmospheric spray cooling systems, 5:34035
COOLING SYSTEMS/SPRAY COOLING
Unit thermal performance of atmospheric spray cooling systems, 5:34035
COPPER/LIGHT TRANSMISSION
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
COPPER/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
COPPER/MUONIC ATOMS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
COPPER/PHOTOEMISSION
High-resolution angle-resolved-photoemission studies of the MB-point surface state on Cu (001), 5:33876
COPPER/SPECTRAL REFLECTANCE
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
COPPER/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
COPPER/TOXICITY
Possible adverse effects of trace materials, 5:34206 (BNL—51118)
COPPER 64/PION MINUS REACTIONS
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
COPPER ALLOYS
See also COPPER BASE ALLOYS
COPPER ALLOYS/CORROSION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
COPPER ALLOYS/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
COPPER ALLOYS/PHYSICAL RADIATION EFFECTS
Effects of radiation-induced segregation and preferential sputtering on the sputtering rate of alloys, 5:33896
COPPER BASE ALLOYS/DEFORMATION
Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865
COPPER BASE ALLOYS/SUPERCONDUCTIVITY
Experimental studies in solid state and low temperature physics. Final report for 1966-1980, 5:34378 (DOE/ER/01569—147)
CORN (MAIZE)
See MAIZE
CORN OIL/CHEMICAL COMPOSITION
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
CORN OIL/PHYSICAL PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
CORN OIL/THERMODYNAMIC PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
CORN STOVER
See AGRICULTURAL WASTES
COSMIC RAY PROPAGATION/HEAVY ION REACTIONS
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
COSMOCHEMISTRY/PHASE DIAGRAMS
Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds, 5:34237
COSMOCHEMISTRY/PHASE STUDIES
Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds, 5:34237

COSMOS
See UNIVERSE
COTTONSEED OIL/CHEMICAL COMPOSITION
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
COTTONSEED OIL/PHYSICAL PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
COTTONSEED OIL/THERMODYNAMIC PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
COVERINGS/LIGHT SCATTERING
Specularity measurements for solar materials, 5:33538
COVERINGS/OPTICAL PROPERTIES
Specularity measurements for solar materials, 5:33538
CRACKS/CONFIGURATION
Crack depth determination by ultrasonic frequency analysis aided by dynamic photoelasticity, 5:34045 (IS-T—900)
CRACKS/DETECTION
Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
CRACKS/STRESS INTENSITY FACTORS
Transient response of a single-edge crack in an elastic half-plane, 5:33955 (SAND—80-1877C)
CRAY COMPUTERS/PERFORMANCE
Performance evolution in a large scale system (DEMOS operating system), 5:34444 (LA-UR—80-1185)
C-REACTIVE PROTEIN
See IMMUNITY
CREEP/FINITE ELEMENT METHOD
Simulation of a bench scale experiment with an empirical creep law. Technical report, 5:34227 (ONWI—99)
CREEP/FORECASTING
Simulation of a bench scale experiment with an empirical creep law. Technical report, 5:34227 (ONWI—99)
CREEP/MATHEMATICAL MODELS
Finite element modeling of long-term fluid-structure interaction problems in geological media, 5:34225 (LA-UR—79-3016)
CRITICAL ORGANS
Radiation carcinogenesis in man. A critical review, 5:34186 (EML—380)
CRITICAL ORGANS/INTERNAL IRRADIATION
CAMIRD III: Computer Assisted Medical Internal Radiation Dosimetry. FORTRAN IV version, 5:34191 (DOE/EV/10303—5)
CRITICAL ORGANS/RADIATION DOSES
CAMIRD III: Computer Assisted Medical Internal Radiation Dosimetry. FORTRAN IV version, 5:34191 (DOE/EV/10303—5)
CRITICALITY/MONITORING
Response of a fast neutron criticality monitor to prompt critical bursts, 5:34092
CRUDE OIL
See PETROLEUM
CRYOPUMPS/DESIGN
TSTA compound cryopump, 5:34437 (UCRL—84456)
CRYOSTATS/COST
Cryocoolers for superconductive electronics, 5:34011
CRYOSTATS/PERFORMANCE
Cryocoolers for superconductive electronics, 5:34011
CRYSTAL STRUCTURE/COMPUTER CODES
FOUR: a general crystallographic Fourier program, 5:34369 (IS—4737)
CRYSTAL STRUCTURE/ELECTRON DENSITY
FOUR: a general crystallographic Fourier program, 5:34369 (IS—4737)
CT SCANNING
See CAT SCANNING
CULTIVATION TECHNIQUES/ENVIRONMENTAL EFFECTS
Comparison of soil surface arthropod populations in conventional tillage, no-tillage and old field systems, 5:34182 (DOE/EV/00641—41)
CURIUM 245/ALPHA DECAY
Gamma rays following alpha decay of ^{245}Cm and the level structure of ^{241}Pu, 5:34344
CURIUM 245 TARGET/NEUTRON REACTIONS
Fission cross section of ^{245}Cm (10 to 32 eV), 5:34347 (UCID—18577)
CYLINDERS/SINTERING
Numerical methods for analyzing sintering by surface diffusion, 5:33913
CYLINDRICAL PARABOLIC COLLECTORS
See PARABOLIC TROUGH COLLECTORS

D

D PLUS RESONANCES
See D-1865 RESONANCES
D RESONANCES
See also D-1865 RESONANCES
D RESONANCES/LIFETIME
Ratio of D^0 and D^+ lifetimes from their semileptonic decays, 5:34280 (SLAC-PUB—2532)
D RESONANCES/SEMILEPTONIC DECAY
Ratio of D^0 and D^+ lifetimes from their semileptonic decays, 5:34280 (SLAC-PUB—2532)
D ZERO RESONANCES
See D-1865 RESONANCES
D-1865 RESONANCES/PARTICLE PRODUCTION
Charmed mesons produced in $e^+ e^-$ annihilations, 5:34277
DARRIEUS ROTORS/STRESS ANALYSIS
VAWTDYN: a numerical package for the dynamic analysis of vertical axis wind turbines, 5:33585 (SAND—80-0085)
DATA ACQUISITION SYSTEMS/REMOTE MULTIPLEXING SYSTEMS
Single transmission line interrogated multiple channel data acquisition system (Patent), 5:34456
DATA BASE MANAGEMENT/ALGORITHMS
Efficient access of compressed data, 5:34459 (LBL—10648)
DATA BASE MANAGEMENT/INFORMATION VALIDATION
Integrated approach to data editing, 5:34457 (CONF-800820—5)
DATA BASE MANAGEMENT/MEETINGS
Workshop: data management needs for atmospheric deposition, 5:34122 (EPRI-WS—79-163)
DATA BASE MANAGEMENT/PROGRAMMING
Implementation of logical networks in System 2000 data bases, 5:34460 (SAND—80-125 C)
DATA STORAGE DEVICES
See MEMORY DEVICES
DC TO DC CONVERTERS/DESIGN
The application of dc-dc energy conversion in a solar energy system. Final report, 5:33441 (AD-A—077112)
DECISION MAKING/MATHEMATICAL MODELS
Simulation approach to a regional resource environment conflict, 5:34166 (CONF-800819—2)
DECOMMISSIONING
See REACTOR DECOMMISSIONING
DECOMMISSIONING/COST
Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
DECOMMISSIONING/RADIATION HAZARDS
Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
DECOMMISSIONING/SAFETY
Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
DEEP INELASTIC HEAVY ION REACTIONS/REVIEWS
Search for collective phenomena in relativistic nuclear collisions, 5:34360 (LBL—11123)
DEEP INELASTIC SCATTERING/SHADOW EFFECT
Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957)
DEFORMATION/MEASURING INSTRUMENTS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
DEFORMATION/MEASURING METHODS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
DEFORMED NUCLEI/BACKBENDING
Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
DEFORMED NUCLEI/ENERGY LEVELS
Bandcrossing in K unequal 0 bands, 5:34339
DELAWARE/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
DELAYED NEUTRONS/FISSION YIELD
Time dependent beta-delayed neutrons from fissioning systems, 5:34349 (UCID—18577)
DEMOGRAPHY
Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory, 5:33673 (LBL—11349)
DEMONSTRATION PLANTS
See also INDUSTRIAL PLANTS
PILOT PLANTS

DEMONSTRATION PLANTS/RISK ASSESSMENT
Demonstration plant supplementary technical studies section 10-confidence analysis. SRC-II demonstration project, phase zero, task number 1, deliverable number 3, 5:33198 (DOE/ET/11328—T1)
DEMONSTRATION PROGRAMS
See also COMMERCIALIZATION
DEMONSTRATION PROGRAMS/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
DENSITOMETERS/PERFORMANCE
Gamma scattering, 5:34087 (CONF-800747—3)
DENSITOMETERS/SPECIFICATIONS
Gamma scattering, 5:34087 (CONF-800747—3)
DEOXYRIBONUCLEASE
See DNA-ASE
DESIGN/GAS GENERATORS
Process and system for recovering hydrocarbons from underground formations (Patent), 5:33250
DESULFURIZATION
See also ADIP PROCESS
SELEXOL PROCESS
SULFINOL PROCESS
DESULFURIZATION/CATALYSTS
Cobalt-molybdenum-alumina desulfurization catalyst (Patent), 5:33254
DESULFURIZATION/TECHNOLOGY UTILIZATION
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
DETONATION WAVES
See SHOCK WAVES
DETONATORS/DESIGN
Deflagration-to-detonation transition project: quarterly report for the period September through November 1979, 5:34103 (SAND—80-1157)
DEUTERIUM COMPOUNDS
See also DEUTERIUM TRITIDES
DEUTERIUM COMPOUNDS/RAMAN SPECTRA
Raman scattering from NH_4^+ and ND_4^+ in beta-alumina, 5:34245
DEUTERIUM OXIDES
See HEAVY WATER
DEUTERIUM TARGET/PROTON REACTIONS
Measurement of $p+d \rightarrow {}^3He+\gamma$ and comparison with the inverse reaction, 5:34315
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{3}Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
Slope parameter for the differential cross-section for the reaction p + d → X + d in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)
DEUTERIUM TRITIDES/ELECTRIC CONDUCTIVITY
Dielectric constant and electrical conductivity of liquid D-T, 5:33346
DEUTERIUM TRITIDES/PERMITTIVITY
Dielectric constant and electrical conductivity of liquid D-T, 5:33346
DEUTERON REACTIONS/ELASTIC SCATTERING
Nucleus-nucleus total reaction cross sections, 5:34317
DEUTERON REACTIONS/ONE-NUCLEON TRANSFER REACTIONS
Neutron environment in d + Li facilities, 5:34082 (HEDL-SA—2123-FP)
DEUTERON REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
DEUTERON-DEUTERON INTERACTIONS
See DEUTERIUM TARGET
DEUTERON REACTIONS
DEUTERONS/BINDING ENERGY
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
DEVELOPED COUNTRIES/ENERGY CONSUMPTION
Trends in energy use in industrial societies. Final report, 5:33742 (EPRI-EA—1471)
DEVELOPING COUNTRIES/RENEWABLE ENERGY SOURCES
Developing common information elements for renewable energy systems: summary and proceedings of the SERI/AID workshop, 5:33744 (SERI/TP—744-661)
DIAMONDS/PHOTOEMISSION
Comment on "Quantum photoyield of diamond (111): A stable negative-affinity emitter", 5:33919
DIATOMACEOUS EARTH/SORPTIVE PROPERTIES
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
DIBORANE
See BORANES
DIELECTRIC MATERIALS/FLUORESCENCE
Raman and fluorescent scattering by molecules embedded in dielectric spheroids, 5:34391
DIELECTRIC MATERIALS/RAMAN EFFECT
Raman and fluorescent scattering by molecules embedded in dielectric spheroids, 5:34391
DIELECTRICS
See DIELECTRIC MATERIALS
DIESEL ENGINES/FUEL CONSUMPTION
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
DIESEL ENGINES/PERFORMANCE TESTING
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
DIESEL ENGINES/TECHNOLOGY ASSESSMENT
Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
DIESEL FUELS/COMPARATIVE EVALUATIONS
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
DIESEL FUELS/MIXING
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
DIFFERENTIAL EQUATIONS
See also BOLTZMANN EQUATION
MAXWELL EQUATIONS
DIFFERENTIAL EQUATIONS/ANALYTICAL SOLUTION
Calculation of similarity solutions of partial differential equations, 5:34403 (ORNL/TM—7407)
DIFFERENTIAL EQUATIONS/BOUNDARY-VALUE PROBLEMS
Compact, implicit difference schemes for a differential equation's side conditions, 5:34455
DIFFERENTIAL EQUATIONS/EIGENVALUES
Collocation approximation to eigenvalues of an ordinary differential equation: The principle of the thing, 5:34454
DIFFERENTIAL EQUATIONS/NUMERICAL SOLUTION
Block relaxation strategies, 5:34445 (LA-UR—80-2342)
Computational experience with an explicit difference scheme for a one phase Stefan problem, 5:34388 (ORNL/CSD—62)
Implementing techniques for elliptic problems on vector processors, 5:34446 (LA-UR—80-2343)
Variable interval variable step method for the solution of linear second order coupled differential equations, 5:34383
DIFFRACTION METHODS/LEAST SQUARE FIT
Radial distribution least-squares program (RADILS) users manual. Memorandum report, 5:33924 (AD-A—076964)
DIFFUSION/KINETICS
Carrier facilitated transport through membranes, 5:33926 (ANL—80-71)
DIMETHYLKETONE
See ACETONE
2-2-DIMETHYLPROPANE/HYDROGENATION
Mechanistic study of the hydrogenolysis of neopentane on iridium, 5:33934 (IS-T—909)
DIOLS
See GLYCOLS
DIRECT GAIN SYSTEMS/PERFORMANCE
Hodges residence: performance of a direct gain passive solar home in the 1979-1980 heating season, 5:33474 (IS-M—290)
Sensitivity of direct gain performance to detailed characteristics of the living space, 5:33478 (LA-UR—80-2266)
DISEASES
See also NEOPLASMS
RESPIRATORY SYSTEM DISEASES
DISEASES/DIAGNOSTIC TECHNIQUES
Biomedical applications of SQUIDs, 5:33969
DISPLACEMENT RATES/CALCULATION METHODS
Random choice method for calculating fluid displacement in a porous medium, 5:33247 (LBL—11086)
DISPLACEMENT RATES/MEASURING INSTRUMENTS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
DISPLACEMENT RATES/MEASURING METHODS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
DISTILLATES/COST
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
DISTRICT HEATING/DECISION MAKING
Overview of Twin Cities district-heating studies, 5:33805 (CONF-790401—)
DISTRICT HEATING/ENERGY SOURCES
Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—)

DISTRICT HEATING/ENVIRONMENTAL IMPACTS
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—)
DISTRICT HEATING/EVALUATION
Suitability of the CASES software for evaluation of district heating systems based on annual storage cycles, 5:33802 (ANL/CNSV-TM—40)
DISTRICT HEATING/FEASIBILITY STUDIES
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
Feasibility of a large-scale cogeneration/hot-water district-heating system in the Twin Cities, 5:33806 (CONF-790401—)
Overview of Twin Cities district-heating studies, 5:33805 (CONF-790401—)
St. Paul district-heating study, 5:33808 (CONF-790401—)
DISTRICT HEATING/HOT WATER
Overview of Twin Cities district-heating studies, 5:33805 (CONF-790401—)
DISTRICT HEATING/INSTITUTIONAL FACTORS
Twin Cities institutional issues study: cogenerated hot-water district heating, 5:33807 (CONF-790401—)
DISTRICT HEATING/MEETINGS
District-heating/cogeneration symposium, 5:33803 (CONF-790401—)
DISTRICT HEATING/PERFORMANCE
European district-heating experience with focus on Uppsala hot-water district-heating system, 5:33804 (CONF-790401—)
DISTRICT HEATING/PLANNING
Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—)
DIVERTORS
See also PDX DEVICES
POLOIDAL DIVERTORS
DIVERTORS/PERFORMANCE TESTING
Divertor experiments in a toroidal plasma, with E x B drift due to an applied radial electric field, 5:34433 (COO—2387-117)
DNA-ASE/CHEMICAL PROPERTIES
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
DNA-ASE/PURIFICATION
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
DOSE-RESPONSE RELATIONSHIPS/EXTRAPOLATION
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
DOSIMETRY/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
DOUBLET 3 DEVICES
See DOUBLET REACTORS
DOUBLET REACTORS/POLOIDAL DIVERTORS
Properties of diverted plasmas with magnetically expanded flux surfaces, 5:34399 (GA-A—15963)
DRILL BITS/COMPUTER CODES
User/programmer guide for UCMD100 set point manipulation from magnetic tape coordinate data, 5:33571 (SAND—80-1585)
DRILL BITS/INSTALLATION
User/programmer guide for UCMD100 set point manipulation from magnetic tape coordinate data, 5:33571 (SAND—80-1585)
DRILL BITS/LUBRICANTS
Seal/lubricant systems for geothermal drilling equipment, 5:33572 (SAND—80-7101)
DRILL BITS/PERFORMANCE TESTING
Laboratory and field testing of improved geothermal rock bits, 5:33573 (SAND—80-7102)
DRILL BITS/SEALS
Seal/lubricant systems for geothermal drilling equipment, 5:33572 (SAND—80-7101)
DRILL CORES/DISSOLUTION
Basic data report for drillhole WIPP 30 (Waste Isolation Pilot Plant - WIPP), 5:33330 (SAND—79-0284)
DRILL CORES/GEOCHEMISTRY
Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide), 5:33562 (DOE/ID/12079—6)
DRILLING FLUIDS/BIOLOGICAL EFFECTS
Investigating the impact of drilling mud and its major components on bivalve species of Georges Bank. Progress report, March 1, 1979-February 29, 1980, 5:34204 (DOE/EV/04580—T1)
DRILLING FLUIDS/CHEMICAL COMPOSITION
Investigating the impact of drilling mud and its major components on bivalve species of Georges Bank. Progress report, March 1, 1979-February 29, 1980, 5:34204 (DOE/EV/04580—T1)
DRILLING MUD
See DRILLING FLUIDS
DRILLING PLATFORMS
See OFFSHORE PLATFORMS
DRUGS
See also RADIOPHARMACEUTICALS
DRUGS/COMPARATIVE EVALUATIONS
Ethical procedures in comparative evaluation of drugs, 5:34172 (COO—3077-163)
DRY-TYPE COOLING TOWERS
See CLOSED-CYCLE COOLING SYSTEMS
DUSTS/AIR POLLUTION CONTROL
Adsorption of moisture by grain dust and control of dust hazards, 5:34124 (IS-M—285)
DYSPROSIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
DYSPROSIUM 152/YRAST STATES
Yrast spectra of ^{140}Gd, ^{147}Gd and ^{152}Dy in the deformed independent particle model, 5:34330 (ANL/PHY—79-4)
DYSPROSIUM 164 TARGET/ARGON 40 REACTIONS
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336

E

EARTH ATMOSPHERE
See also SURFACE AIR
EARTH ATMOSPHERE/CIRCULATING SYSTEMS
Effects of atmospheric variability on energy utilization and conservation. Progress report, 5:34113 (COO—1340-76)
EARTH ATMOSPHERE/PHOTON TRANSPORT
Experimental atmospheric extinction measurements at nine wavelengths between 0.3 and 10 μm, 5:33383
EARTH ATMOSPHERE/RADIONUCLIDE MIGRATION
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
EARTHQUAKES/GROUND MOTION
LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980, 5:34221 (UCRL—52956)
EARTHQUAKES/SEISMIC EFFECTS
Dynamic behavior of LLNL buildings during aftershocks of the January 24, 1980 Greenville earthquake, 5:34222 (UCRL—52969)
LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980, 5:34221 (UCRL—52956)
EAST MESA GEOTHERMAL FIELD/GEOTHERMAL POWER PLANTS
Test results from the 500 kW direct contact pilot plant at East Mesa, 5:33569 (LBL—11107)
EDUCATION
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
EDUCATION/DEMONSTRATION PROGRAMS
Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)
EDUCATIONAL FACILITIES
See also SCHOOL BUILDINGS
EDUCATIONAL FACILITIES/ICES
University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—)
EDUCATIONAL FACILITIES/REFUSE-FUELED POWER PLANTS
University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—)
EFFLUENTS (CHEMICAL)
See CHEMICAL EFFLUENTS
EHF RADIATION
See MICROWAVE RADIATION
EHV AC SYSTEMS/GAS-INSULATED CABLES
High-temperature gas-insulated systems. Final report, 5:33605 (EPRI-EL—1500)
EHV AC SYSTEMS/OIL-FILLED CABLES
Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979, 5:33602 (CONS—3122-T2)
EHV DC SYSTEMS/ELECTRICAL INSULATORS
Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
EINSTEINIUM 250/ELECTRON CAPTURE DECAY
Low-spin states of ^{250}Cf populated in the electron capture decay of 2.22-h ^{250}Es, 5:34345

ELECTRIC BATTERIES
(Devices for production and/or storage of electrical energy from chemical reactions; excludes FUEL CELLS and RADIOISOTOPE BATTERIES.)
See also LEAD-ACID BATTERIES
METAL-GAS BATTERIES
ELECTRIC BATTERIES/COST
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
ELECTRIC BATTERIES/DESIGN
Electrically rechargeable battery (Patent; Zn anode with circulating ferricyanide salt; 35 mA/cm², 1.4 V, 91% efficient), 5:33643
Electrochemical generators with auxiliary cathode (Patent), 5:33650
ELECTRIC BATTERIES/EVALUATION
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
ELECTRIC BATTERIES/HEATERS
Circuits for heating storage batteries (Patent), 5:33657
ELECTRIC BATTERIES/POSITIONING
Battery clamping and retention (Patent), 5:33836
ELECTRIC BRIDGES/DESIGN
Bridge cutout (Austrian Patent), 5:33958 (SAND—80-6016)
Bridge cutout, in particular for incandescent lamps to be connected in series (Austrian Patent), 5:33959 (SAND—80-6017)
ELECTRIC CABLES
See also GAS-INSULATED CABLES
OIL-FILLED CABLES
SUPERCONDUCTING CABLES
ELECTRIC CABLES/ELECTRICAL INSULATION
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
ELECTRIC CABLES/MANUALS
Handbook for photovoltaic cabling, 5:33444 (COO—4094-90)
ELECTRIC CONDENSERS
See CAPACITORS
ELECTRIC GENERATORS
(Rotating generators only; excludes DIRECT ENERGY CONVERTERS.)
See also WATER CURRENT POWER GENERATORS
ELECTRIC GENERATORS/FREQUENCY RESPONSE TESTING
Determination of synchronous machine stability study constants. Final report, 5:33591 (EPRI-EL—1424(Vol.3))
ELECTRIC GENERATORS/STABILITY
Determination of synchronous machine stability study constants. Final report, 5:33591 (EPRI-EL—1424(Vol.3))
ELECTRIC HEATING
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)
ELECTRIC MOTORS/CONTROL EQUIPMENT
Asynchronous drive for an electric automobile under slip conditions, 5:33825 (DOE-tr—230)
ELECTRIC MOTORS/DESIGN
Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control, 5:33830 (DOE-tr—237)
Builtin asynchronous electric motor for a light passenger automobile motor-wheel, 5:33828 (DOE-tr—233)
ELECTRIC MOTORS/OPERATION
Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control, 5:33830 (DOE-tr—237)
Builtin asynchronous electric motor for a light passenger automobile motor-wheel, 5:33828 (DOE-tr—233)
ELECTRIC MOTORS/OPTIMIZATION
Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles, 5:33832 (DOE-tr—239)
ELECTRIC MOTORS/PERFORMANCE
Asynchronous drive for an electric automobile under slip conditions, 5:33825 (DOE-tr—230)
ELECTRIC POWER
See also BONNEVILLE POWER ADMINISTRATION
HYDROELECTRIC POWER
ELECTRIC POWER/CONSUMPTION RATES
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
ELECTRIC POWER/COST
Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM-[illegible])
ELECTRIC POWER/DEMAND FACTORS
Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
ELECTRIC POWER/MARGINAL-COST PRICING
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
ELECTRIC POWER/RATE STRUCTURE
Electric Utility Rate Design Study: the accounting-cost basis for evaluating block rates, 5:33725
ELECTRIC POWER/SOCIO-ECONOMIC FACTORS
Sociological implications of an energy-deficient society, 5:33669 (CONF-800212—)
ELECTRIC UTILITIES/CAPACITY
Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
Proposed electric power projects, 5:33737 (P—300-80-001)
ELECTRIC UTILITIES/ECONOMIC ANALYSIS
Structure of the electric utility industry, 1990. Final report, 5:33710 (DOE/CS/20258—3)
ELECTRIC UTILITIES/ENVIRONMENTAL QUALITY
Environmental implications of electric-utility supply plans, 1978-2000, 5:33738 (P—300-80-005)
ELECTRIC UTILITIES/FORECASTING
Structure of the electric utility industry, 1990. Final report, 5:33710 (DOE/CS/20258—3)
ELECTRIC UTILITIES/FUEL CONSUMPTION
Environmental assessment of a program to reduce oil and gas consumption by electric utilities, 5:33595 (ANL/EES-TM—97)
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
ELECTRIC UTILITIES/FUEL SUBSTITUTION
Environmental assessment of a program to reduce oil and gas consumption by electric utilities, 5:33595 (ANL/EES-TM—97)
ELECTRIC UTILITIES/FUEL SUPPLIES
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
ELECTRIC UTILITIES/LAND REQUIREMENTS
Gleneden Beach: PUB final report, 5:33730
ELECTRIC UTILITIES/LITHIUM-SULFUR BATTERIES
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
ELECTRIC UTILITIES/LOAD MANAGEMENT
Commercialization strategy for lead/acid batteries in utility load leveling applications, 5:33594 (DOE/ET/26934—1)
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 5:33727
Handbook of five methodologies for the assessment of load management, 5:33709 (ANL/EES-TM—92)
Proceedings of the load-management customer-participation workshop, 5:33729
Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses, 5:33740 (JPL-PUB—80-48(Vol.2))
ELECTRIC UTILITIES/MARGINAL-COST PRICING
Electric Utility Rate Design Study: comments on RDS Report No. 66, An Evaluation of Four Marginal Costing Methodologies, 5:33728
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
ELECTRIC UTILITIES/PLANNING
Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
ELECTRIC UTILITIES/POWER GENERATION
Monthly comparisons of peak demands and energy for load, 1974 to 1978, 5:33731 (DOE/EIA—0010/3)
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
ELECTRIC UTILITIES/RATE STRUCTURE
Electric Utility Rate Design Study: the accounting-cost basis for evaluating block rates, 5:33725
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 5:33727

Electric Utility Rate Design Study: comments on RDS Report No. 66, An Evaluation of Four Marginal Costing Methodologies, 5:33728
ELECTRIC UTILITIES/RENEWABLE ENERGY SOURCES
Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
ELECTRICAL ENGINEERING/BIBLIOGRAPHIES
Annual research summary, July 1, 1979-June 30, 1980, 5:33960
ELECTRICAL ENGINEERING/RESEARCH PROGRAMS
Annual research summary, July 1, 1979-June 30, 1980, 5:33960
ELECTRICAL INSULATION/PERFORMANCE TESTING
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
ELECTRICAL INSULATION/POLYETHYLENES
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
ELECTRICAL INSULATORS/FLASHOVER
Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
ELECTRICAL INSULATORS/PERFORMANCE TESTING
Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
ELECTRIC-POWERED VEHICLES/CERTIFICATION
Electric and hybrid vehicle self-certification and verification procedures: Market Demonstration Program, 5:33834 (DOE/CS—0178(Rev.1))
ELECTRIC-POWERED VEHICLES/CONTROL EQUIPMENT
dc thyristor-capacitor converter for an electric automobile, 5:33827 (DOE-tr—232)
Self-contained inverters with pulse-width voltage regulation for an ac electric drive in an electric passenger automobile, 5:33831 (DOE-tr—238)
System of regulating an electric automobile with an induction traction motor, 5:33833 (DOE-tr—240)
ELECTRIC-POWERED VEHICLES/CONTROL SYSTEMS
Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control, 5:33830 (DOE-tr—237)
Research and optimization of static operating conditions for battery-powered electric automobiles, 5:33829 (DOE-tr—235)
ELECTRIC-POWERED VEHICLES/COST
Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)
ELECTRIC-POWERED VEHICLES/DESIGN
Energy aspects of designing electric automobiles and electrical transmissions for them, 5:33824 (DOE-tr—229)
ELECTRIC-POWERED VEHICLES/ELECTRIC BATTERIES
Battery clamping and retention (Patent), 5:33836
Electrochemical generators with auxiliary cathode (Patent), 5:33650
ELECTRIC-POWERED VEHICLES/ELECTRIC MOTORS
Analysis of electromagnetic processes and energy losses in a self-contained dc electric traction motor with pulse-frequency and pulse-width control, 5:33830 (DOE-tr—237)
Asynchronous drive for an electric automobile under slip conditions, 5:33825 (DOE-tr—230)
Builtin asynchronous electric motor for a light passenger automobile motor-wheel, 5:33828 (DOE-tr—233)
Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles, 5:33832 (DOE-tr—239)
ELECTRIC-POWERED VEHICLES/ENERGY CONSUMPTION
Energy aspects of designing electric automobiles and electrical transmissions for them, 5:33824 (DOE-tr—229)
ELECTRIC-POWERED VEHICLES/LEAD-ACID BATTERIES
Method and apparatus for determining the capacity of lead acid storage batteries (Patent), 5:33652
Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles, 5:33832 (DOE-tr—239)
ELECTRIC-POWERED VEHICLES/MARKET
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
ELECTRIC-POWERED VEHICLES/MATERIAL SUBSTITUTION
Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)
ELECTRIC-POWERED VEHICLES/METAL-GAS BATTERIES
Air battery and electrochemical method (Patent), 5:33645
ELECTRIC-POWERED VEHICLES/NICKEL-ZINC BATTERIES
Methods for perfecting nickel-zinc storage batteries for the power plants of electric automobiles, 5:33826 (DOE-tr—231)
ELECTRIC-POWERED VEHICLES/OPERATION
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
Research and optimization of static operating conditions for battery-powered electric automobiles, 5:33829 (DOE-tr—235)
ELECTRIC-POWERED VEHICLES/SPEED REGULATORS
Self-contained inverters with pulse-width voltage regulation for an ac electric drive in an electric passenger automobile, 5:33831 (DOE-tr—238)
ELECTRIC-POWERED VEHICLES/TECHNOLOGY ASSESSMENT
Hydrogen-air electrochemical energy installation for electric automobiles, 5:33838 (DOE-tr—227)
ELECTRIC-POWERED VEHICLES/VOLTAGE REGULATORS
Load conditions for a storage battery, three-phase voltage inverter and asynchronous traction motor during acceleration of an automobile at set intensity, 5:33823 (DOE-tr—228)
ELECTRIC-POWERED VEHICLES/ZINC-AIR BATTERIES
Electrochemical generators with auxiliary cathode (Patent), 5:33650
ELECTRIC-POWERED VEHICLES/ZINC-CHLORINE BATTERIES
Rechargeable zinc halogen battery (Patent), 5:33651
ELECTRODES
See also CATHODES
ELECTRODES/PERFORMANCE TESTING
Development of the high-temperature redox electrode. Interim report ending March 1980, 5:33564 (PNL—3377)
ELECTRODES/REDOX REACTIONS
Development of the high-temperature redox electrode. Interim report ending March 1980, 5:33564 (PNL—3377)
ELECTROLYTE TILES
See MATRIX MATERIALS
ELECTROLYTIC CELLS/DESIGN
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
ELECTROLYTIC CELLS/PERFORMANCE TESTING
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
ELECTROMAGNETIC RADIATION
See also GAMMA RADIATION
INFRARED RADIATION
LASER RADIATION
MICROWAVE RADIATION
X RADIATION
ELECTROMAGNETIC RADIATION/INTERACTIONS
Theory of resonance-radiation pressure, 5:34264
ELECTROMAGNETIC RADIATION/RADIATION PRESSURE
Theory of resonance-radiation pressure, 5:34264
ELECTRON BEAM TARGETS/ENERGY TRANSFER
Particle beam interactions with plasmas and their application to inertial fusion, 5:34432
ELECTRON BEAMS/ASYMMETRY
Analytic study of azimuthal asymmetries in relativistic hollow e-beams, 5:34241
ELECTRON BEAMS/TRANSPORT THEORY
Relativistic-electron-beam/target interaction in plasma channels, 5:34430
ELECTRON COLLISIONS
See also ELECTRON-ATOM COLLISIONS
ELECTRON COLLISIONS/ANGULAR DISTRIBUTION
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
ELECTRON COLLISIONS/DESORPTION
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
ELECTRON CYCLOTRON MASERS
See MICROWAVE AMPLIFIERS
ELECTRON REACTIONS/ELASTIC SCATTERING
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
ELECTRON REACTIONS/INELASTIC SCATTERING
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
Suppression of the transverse scattering amplitude in ^{207}Pb, 5:34341
ELECTRON-ATOM COLLISIONS/ELASTIC SCATTERING
Large-momentum-transfer limit of some matrix elements, 5:34261
ELECTRON-ATOM COLLISIONS/INELASTIC SCATTERING
Large-momentum-transfer limit of some matrix elements, 5:34261
ELECTRON-POSITRON INTERACTIONS/ANNIHILATION
Charmed mesons produced in e^+e^- annihilations, 5:34277
tauν decay signature for detecting F^{+-} and B^{+-} mesons in e^+e^- collisions, 5:34292

ELECTRON-POSITRON INTERACTIONS/HARD COLLISION MODELS
Nonperturbative vacuum and hard scattering processes, 5:34301 (FERMILAB-CONF—80/68-THY)
ELECTRON-POSITRON INTERACTIONS/TOTAL CROSS SECTIONS
From the psi to charm: The experiments of 1975 and 1976 (Nobel prize lecture), 5:34278
ELEMENTARY PARTICLES
See also HADRONS
ELEMENTARY PARTICLES/RESEARCH PROGRAMS
Progress report on research program in elementary particle theory, 1979-1980 (Univ. of Texas at Austin), 5:34300 (DOE/ER/03992—392)
EMPLOYMENT
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
EMPLOYMENT/FORECASTING
Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory, 5:33673 (LBL—11349)
END USE SECTOR
See COMMERCIAL SECTOR
INDUSTRY
ENERGY
See also GEOTHERMAL ENERGY
SOLAR ENERGY
ENERGY/FINANCIAL INCENTIVES
Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)
ENERGY/MEETINGS
Energy in the '80s: decade of decision, 5:33667 (CONF-800212—)
ENERGY/PERSONNEL
Directory of North Carolina energy-resource personnel, 5:33816 (NCEI—0017)
ENERGY/PUBLIC RELATIONS
Energy in the '80s: decade of decision, 5:33667 (CONF-800212—)
ENERGY/SOCIO-ECONOMIC FACTORS
Energy in the '80s: decade of decision, 5:33667 (CONF-800212—)
ENERGY/TAXES
Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)
ENERGY ANALYSIS
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
ENERGY ANALYSIS/COMPUTER CODES
DOE-2. Part 1. Reference manual. Version 2.1, 5:33762 (LA—7689-M(Ver.2.1))
DOE-2 sample run book. Version 2.1, 5:33763 (LBL—8678(Rev.1))
ENERGY ANALYSIS/ENERGY MODELS
Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL), 5:33665 (BNL—51199)
Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)
ENERGY CONSERVATION/ATTITUDES
Residential energy conservation, 5:33782 (OTA-E—92(Vol.1))
ENERGY CONSERVATION/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
ENERGY CONSERVATION/DATA COMPILATION
Energy conservation opportunities. Volume II, 5:33770
ENERGY CONSERVATION/ECONOMIC ANALYSIS
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
ENERGY CONSERVATION/ECONOMIC IMPACT
Energy and labor implication of improving thermal integrity of new houses. Final report, 5:33692 (DOE/CS/20258—2)
ENERGY CONSERVATION/ECONOMICS
Effects of atmospheric variability on energy utilization and conservation. Progress report, 5:34113 (COO—1340-76)
ENERGY CONSERVATION/ENERGY MANAGEMENT
Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries., 5:33786
ENERGY CONSERVATION/EVALUATION
Ranking energy-conservation measures to establish research priorities: synopsis of a workshop, 5:33690 (BNL—51046)
Uncertainties in our understanding of energy conservation, 5:33774 (CONF-800835—2)
ENERGY CONSERVATION/LIFE-CYCLE COST
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
ENERGY CONSERVATION/OPTIMIZATION
Effect of resource impact factors on energy conservation standards for buildings, 5:33768 (NBS-BSS—114)
ENERGY CONSERVATION/PLANNING
Energy conserving site design: Greenbrier case study, Chesapeake, Virginia. Final report, 5:33800 (DOE/CS/24216—1)
ENERGY CONSERVATION/RESEARCH PROGRAMS
Ranking energy-conservation measures to establish research priorities: synopsis of a workshop, 5:33690 (BNL—51046)
ENERGY CONSERVATION/SOCIAL IMPACT
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
ENERGY CONSERVATION/SOCIO-ECONOMIC FACTORS
Energy and labor implication of improving thermal integrity of new houses. Final report, 5:33692 (DOE/CS/20258—2)
Job shifts from energy conservation: salary distribution effects. Final report, 5:33693 (DOE/CS/20258—2)
Labor and energy impacts of energy-conservation measures, 5:33694 (DOE/CS/20258—2)
ENERGY CONSERVATION/STANDARDS
Effect of resource impact factors on energy conservation standards for buildings, 5:33768 (NBS-BSS—114)
ENERGY CONSUMPTION/ATTITUDES
Attitudes toward energy use and policy in New Mexico, 5:33818
ENERGY CONSUMPTION/DATA COMPILATION
Energy data report: annual energy balance, 1978, 5:33757 (DOE/EIA—0181)
ENERGY CONSUMPTION/FORECASTING
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
Energy consumption: case of the Ivory Coast, Senegal and Ghana (Electricity and gasoline), 5:33743
ENERGY CONSUMPTION/GROSS DOMESTIC PRODUCT
Trends in energy use in industrial societies. Final report, 5:33742 (EPRI-EA—1471)
ENERGY CONSUMPTION/GROSS NATIONAL PRODUCT
International energy indicators, 5:33663 (DOE/IA—0010/2)
ENERGY CONSUMPTION/PUBLIC OPINION
Attitudes toward energy use and policy in New Mexico, 5:33818
ENERGY CONSUMPTION/SOCIAL IMPACT
Energy use and human life styles, 5:33677
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
ENERGY CONSUMPTION/TAXES
Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)
ENERGY DEMAND
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
ENERGY DEMAND/FORECASTING
Oregon's energy future. Fourth annual report, January 1, 1980, 5:33698
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)
Energy consumption: case of the Ivory Coast, Senegal and Ghana (Electricity and gasoline), 5:33743
ENERGY FACILITIES
See also RESOURCE RECOVERY FACILITIES
ENERGY FACILITIES/ENERGY DEMAND
Projected annual resource requirements at the national and regional level for the Department of Commerce energy forecast, 1985 and 2000, 5:33700 (PB—80-126956)
ENERGY FACILITIES/SITE SELECTION
Siting energy related facilities in Louisiana's coastal zone, 5:34155
ENERGY INFORMATION ADMINISTRATION
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)
ENERGY MODELS
Comparative review of the Time-stepped Energy System Optimization Model (TESOM) and the IEA Market Allocation Model (MARKAL), 5:33665 (BNL—51199)
Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification (Description of subprograms BEHAV, DEMAND, ECON, ENER, and INGEN), 5:33713 (P—300-80-007)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures (Data requirements for subprograms BEHAV, DEMAND, ECON, ENER, and INGEN), 5:33714 (P—300-80-008)

Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects (Description of subprograms DEMAND, ENER, and INGEN), 5:33716 (P—300-80-010)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects (Description of subprograms BEHAV and ECON), 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification (Submodels DEMAND, ECON, ENER, and INGEN), 5:33724 (P—300-80-018)
Macroeconomic effects of accelerated implementation of renewable energy technologies in the US, 5:33368 (BNL—51092)

ENERGY MODELS/ENVIRONMENTAL IMPACTS
Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979, 5:33666 (LBL—11183)

ENERGY POLICY
Energy in the '80s: decade of decision, 5:33667 (CONF-800212—)
Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176

ENERGY POLICY/ADMINISTRATIVE PROCEDURES
Energy policy in Australia: the social/institutional context and procedures for policy formulation, 5:33703

ENERGY POLICY/ECONOMIC IMPACT
Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)

ENERGY POLICY/ENVIRONMENTAL IMPACTS
Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)
Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979, 5:33666 (LBL—11183)

ENERGY POLICY/POLITICAL ASPECTS
Alternating energy currents, 5:33668 (CONF-800212—)
Politics of energy, 5:33670 (CONF-800212—)

ENERGY POLICY/PUBLIC OPINION
Alternating energy currents, 5:33668 (CONF-800212—)

ENERGY POLICY/RECOMMENDATIONS
Energy policy: do's and don'ts for the '80s, 5:33695 (CONF-800212—)

ENERGY SHORTAGES/SOCIO-ECONOMIC FACTORS
Sociological implications of an energy-deficient society, 5:33669 (CONF-800212—)

ENERGY SOURCE DEVELOPMENT/ECONOMIC IMPACT
Macroeconomic effects of accelerated implementation of renewable energy technologies in the US, 5:33368 (BNL—51092)

ENERGY SOURCE DEVELOPMENT/ENVIRONMENTAL IMPACTS
Energy policy study. Volume 12. Governmental actions affecting the environment and their effects on energy markets, 5:34140 (DOE/EIA—0201/12)
Energy-related perturbations of the northeast coastal zone: five years (1974-1979) of oceanographic research at Brookhaven National Laboratory, 5:34163 (BNL—51211)

ENERGY SOURCE DEVELOPMENT/FINANCING
Feasibility of financing domestic energy development during 1978-1984. Analysis report AR/EI/79-26, 5:33697 (DOE/EIA—0181/2)

ENERGY SOURCE DEVELOPMENT/MANAGEMENT
Business strategy groups lessons learned, 5:34439 (DOE/PR—0041)

ENERGY SOURCE DEVELOPMENT/POLLUTION CONTROL
EPA energy/environmental control technology program. EPA program summary, 5:34118 (EPA—600/8-80-020)

ENERGY SOURCE DEVELOPMENT/POLLUTION LAWS
Energy policy study. Volume 12. Governmental actions affecting the environment and their effects on energy markets, 5:34140 (DOE/EIA—0201/12)

ENERGY SOURCE DEVELOPMENT/RISK ASSESSMENT
Daily risks of life, 5:33678 (CONF-800212—)
Political side of risk: a new approach, 5:33675 (SAND—80-1871C)

ENERGY SOURCE DEVELOPMENT/TECHNOLOGY ASSESSMENT
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)

ENERGY STORAGE
See also ANNUAL ENERGY STORAGE
COMPRESSED AIR ENERGY STORAGE
FLYWHEEL ENERGY STORAGE
HEAT STORAGE
OFF-PEAK ENERGY STORAGE

ENERGY STORAGE/LOAD MANAGEMENT
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)

ENERGY STORAGE SYSTEMS/COMPARATIVE EVALUATIONS
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))

ENERGY SUPPLIES/FINANCING
Feasibility of financing domestic energy development during 1978-1984. Analysis report AR/EI/79-26, 5:33697 (DOE/EIA—0181/2)

ENERGY SUPPLIES/FORECASTING
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)

ENERGY SUPPLIES/GLOBAL ASPECTS
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)

ENERGY SUPPLIES/PRODUCTION
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)

ENERGY SUPPLIES/RECOMMENDATIONS
Energy policy: do's and don'ts for the '80s, 5:33695 (CONF-800212—)

ENERGY SUPPLIES/SOCIAL IMPACT
Our energy horizons: a missing perspective, 5:33676

ENERGY SUPPLIES/SUPPLY AND DEMAND
Energy data report: annual energy balance, 1978, 5:33757 (DOE/EIA—0181)

ENERGY SUPPLIES/TRANSPORT
Transport and distribution costs of conventional heat-supply systems in the Federal Republic of Germany. Applied Systems Analysis report No. 13, 5:33761 (Juel-Spez—57)

ENGLAND
See UNITED KINGDOM

ENHANCED RECOVERY
See also MISCIBLE-PHASE DISPLACEMENT
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)

ENHANCED RECOVERY/DECISION MAKING
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)

ENVIRONMENT/ENERGY MODELS
Proceedings of the workshop on national/regional energy-environmental modeling concepts, May 30-June 1, 1979, 5:33666 (LBL—11183)

ENVIRONMENTAL IMPACTS/SIMULATION
Terrestrial perturbation experiments as an environmental assessment tool, 5:33679 (ORNL/TM—7186)

ENVIRONMENTAL TEMPERATURE
See AMBIENT TEMPERATURE

ENVIRONMENTAL TRANSPORT
See also RADIONUCLIDE MIGRATION

ENVIRONMENTAL TRANSPORT/MATHEMATICAL MODELS
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
Treatment of dynamical processes in two-dimensional models of the troposphere and stratosphere, 5:34132 (UCID—18771)

ENVIRONMENTAL TRANSPORT/RADIATION MONITORING
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)

ENZYMES
See also DNA-ASE
LIGASES
NUCLEASES

ENZYMES/BIOSYNTHESIS
Comprehensive progress report, 1977-1980, 5:34168 (DOE/EV/03083—T1)

ENZYMES/MOLECULAR STRUCTURE
Comprehensive progress report, 1977-1980, 5:34168 (DOE/EV/03083—T1)

EOR
See ENHANCED RECOVERY

EPOXIDES/ACOUSTIC EMISSION TESTING
Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)

EPOXIDES/FRACTURE PROPERTIES
Failure modes and durability of Kevlar/epoxy composites, 5:33909 (UCRL—83875)
EPOXY COMPOUNDS
See EPOXIDES
EQUATIONS (DIFFERENTIAL)
See DIFFERENTIAL EQUATIONS
ERBIUM/ROTATIONAL STATES
Correlation studies of rotational behavior at very high angular momentum, 5:34340
ERBIUM 166/ELECTRON REACTIONS
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
ESCHERICHIA COLI/RADIOSENSITIVITY
Distinction between the roles of O_2 and of O^-_2 in biological radiodamage, 5:34184 (DOE/EV/03221—68)
ESTUARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
ETA MESONS/RADIATIVE DECAY
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)
ETA-549
See ETA MESONS
ETHANAL
See ACETALDEHYDE
1,2-ETHANEDIOL
See GLYCOLS
ETHANOL
See also ETHANOL FUELS
GASOHOL
ETHANOL/COMMERCIALIZATION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
ETHANOL/COMPARATIVE EVALUATIONS
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
ETHANOL/FUEL SUBSTITUTION
Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand, 5:33846 (CONF-790520—)
ETHANOL/MIXING
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
ETHANOL/PHYSICAL PROPERTIES
Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—)
ETHANOL/PRODUCTION
Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—)
Technical and economic assessment motor fuel alcohol from grain and other biomass, 5:33416 (CONF-790520—)
ETHANOL FUELS/COMPARATIVE EVALUATIONS
Driving cycle comparisons of energy economies and emissions from an alcohol and gasoline fueled vehicle, 5:33844 (CONF-790520—)
ETHINE
See ACETYLENE
ETHNIC GROUPS
See MINORITY GROUPS
ETHYLALDEHYDE
See ACETALDEHYDE
ETHYLENE/ATOM-MOLECULE COLLISIONS
Reactions with oxygen atoms, 5:33922 (BNL—50973)
ETHYLENE/DECOMPOSITION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
ETHYLENE/PRODUCTION
Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas (Patent), 5:33356
ETHYLENE GLYCOL
See GLYCOLS
ETHYLENE POLYMERS
See POLYETHYLENES
ETHYNE
See ACETYLENE
EUPHORBIA/CHEMICAL COMPOSITION
Hydrocarbon production from arid land plant species, 5:33413
EUPHORBIA/PLANT BREEDING
Hydrocarbon production from arid land plant species, 5:33413
EUPHORBIA/PRODUCTIVITY
Hydrocarbon production from arid land plant species, 5:33413
EUROPIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
EUROPIUM/SORPTION
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
EVACUATED COLLECTORS/PERFORMANCE
Comparison of solar thermal energy collection using fixed and tracking collectors, 5:33532
EVAPORATION/COMPARATIVE EVALUATIONS
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)
EVEN-EVEN NUCLEI/BACKBENDING
Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
EXCITONS/KINETIC EQUATIONS
Kinetics of excitons, biexcitons and free carriers in Si, 5:34373 (SAND—80-1697C)
EXHAUST GASES/PLUMES
Measurements of jet dispersions simulated in an aeronautical wind tunnel, 5:34114 (AD-A—076578)
EXHAUST GASES/TEMPERATURE MEASUREMENT
Combustion diagnostics using laser spontaneous-Raman scattering. Final report, 1 July 1976-31 October 1978, 5:33940 (AD-A—076514)
EXPLOSIVES
See also CHEMICAL EXPLOSIVES
EXPLOSIVES/WASTE DISPOSAL
Mound Facility explosives incinerator, 5:34102 (MLM—2762(OP))

F

F-1260 RESONANCES/RADIATIVE DECAY
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)
F-1540 RESONANCES/RADIATIVE DECAY
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)
F-2030 RESONANCES/LEPTONIC DECAY
tauν decay signature for detecting F^{+-} and B^{+-} mesons in e^+e^- collisions, 5:34292
F-2030 RESONANCES/PARTICLE PRODUCTION
Charmed mesons produced in e^+e^- annihilations, 5:34277
FARADAY GENERATORS
See MHD GENERATORS
FARMS/ENERGY CONSUMPTION
Make better use of energy: energy budgeting in farming, 5:33792 (NP—25047)
FEDERAL REPUBLIC OF GERMANY/NATURAL GAS INDUSTRY
Annual report, 1979 (In German), 5:33707 (NP—25049)
FEDERAL REPUBLIC OF GERMANY/PETROLEUM INDUSTRY
Annual report, 1979 (In German), 5:33707 (NP—25049)
Mineral oil statistics 1979 for the Federal Republic of Germany with comparative figures for January/December 1978, 5:33268 (NP—24979)
FEDERAL REPUBLIC OF GERMANY/RESIDENTIAL SECTOR
Transport and distribution costs of conventional heat-supply systems in the Federal Republic of Germany. Applied Systems Analysis report No. 13, 5:33761 (Juel-Spez—57)
FEED MATERIALS PLANTS/SOLAR PROCESS HEAT
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor uranium mill solar retrofit. Final technical report, 5:33494 (DOE/SF/10608—1)
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report, executive summary, 5:33495 (DOE/SF/10608—(Exect.Summ.))
FERMILAB ACCELERATOR/NEUTRINO DETECTION
Proposal for a new neutrino detector at Fermilab to study the weak neutral current. Annual technical progress report, 5:34081 (DOE/ER/05023—1)
FERMIONS
See also BARYONS
FERMIONS/MANY-BODY PROBLEM
Generalized Fermi sea for plane-wave Hartree-Fock theory. II. Semirealistic interactions in three dimensions, 5:34350
FERRATES
See IRON OXIDES
FILAMENTS/ACOUSTIC EMISSION TESTING
Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)
FILM BOILING/HEAT TRANSFER
Experimental study of falling liquid film breakdown on a horizontal cylinder during heat transfer, 5:34039
FILMS
(Not for PHOTOGRAPHIC FILMS or NUCLEAR EMULSIONS.)
FILMS/FABRICATION
Soft x-ray transmission gratings, 5:34097 (CONF-800719—11)

FILMS/RESOLUTION
Soft x-ray transmission gratings, 5:34097 (CONF-800719—11)
FILMS/SURFACE TENSION
Wide range high sensitivity film balance, 5:34101
FIREDAMP
See METHANE
FIRES/INHIBITION
Control and extinguishment of LPG fires. Final report, 5:33270 (DOE/EV/06020—T3)
FIRST WALL/RADIOACTIVITY
Safety and personnel access aspects of low activation fusion blankets, 5:34418 (CONF-801011—1)
FISCHER-TROPSCH SYNTHESIS/CATALYSTS
CO hydrogenation over rhodium foil and single crystal catalysts: correlations of catalyst activity, selectivity, and surface composition, 5:33203
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
Erection and operation of a Fischer-Tropsch-pilot plant with liquid-phase reactor, 5:33197 (BMFT-FB-T—80-033)
Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191
FISCHER-TROPSCH SYNTHESIS/CHEMICAL REACTION KINETICS
Applied Fischer-Tropsch kinetics for a flame sprayed iron catalyst, 5:33181
FISH CULTURE
See AQUACULTURE
FISHES
See also SALMON
TROUT
FISHES/AQUACULTURE
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
FISHES/BEHAVIOR
Biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978, 5:34158 (ORNL/TM—7127)
FISHES/TEMPERATURE EFFECTS
Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report, 5:34195 (EPRI-EA—1148(Vol.1))
FISSION NEUTRONS
See also DELAYED NEUTRONS
PROMPT NEUTRONS
FISSION NEUTRONS/MULTIPLICITY
Graphs of the cross sections in the Alternate Monte Carlo Cross Section library at the Los Alamos Scientific Laboratory, 5:34346 (LA—8394-MS)
FISSIONABLE MATERIALS MANAGEMENT
See NUCLEAR MATERIALS MANAGEMENT
FLAME PROPAGATION/NUMERICAL SOLUTION
Application of an explicit numerical method to a reaction-diffusion system in combustion, 5:33942 (COO—3077-162)
FLAMES/SOOT
Chemistry of combustion of fuel-water mixtures. Final technical report, 5:33941 (AD-A—076958)
FLASH HYDROPYROLYSIS PROCESS/PARAMETRIC ANALYSIS
Flash hydropyrolysis of coal. Quarterly report No. 10, July 1-September 30, 1979, 5:33210 (BNL—51172)
FLASH HYDROPYROLYSIS PROCESS/YIELDS
Flash hydropyrolysis of coal. Quarterly report No. 10, July 1-September 30, 1979, 5:33210 (BNL—51172)
Flash hydropyrolysis of lignite and sub-bituminous coals to both liquid and gaseous hydrocarbon products, 5:33196
FLAT PLATE COLLECTORS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
FLAT PLATE COLLECTORS/DESIGN
Flat plate multiple pass solar collector using aqueous optical properties, 5:33530
FLAT PLATE COLLECTORS/FABRICATION
Further development of a low-cost solar panel. Final report, September 28, 1979-May 31, 1980, 5:33513 (ALO—2032-2)
FLAT PLATE COLLECTORS/OPTIMIZATION
Solar energy design improvement: a methodology for hydronic flat plate collector systems, 5:33512 (AD-A—076836)
FLAT PLATE COLLECTORS/PERFORMANCE
Comparison of solar thermal energy collection using fixed and tracking collectors, 5:33532
FLAT PLATE COLLECTORS/PERFORMANCE TESTING
Flat plate multiple pass solar collector using aqueous optical properties, 5:33530
Further development of a low-cost solar panel. Final report, September 28, 1979-May 31, 1980, 5:33513 (ALO—2032-2)
FLOODS/FORECASTING
Inputs for risk analysis in water systems, 5:34159
FLOORS/HEAT TRANSFER
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
FLORIDA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
FLOW BLOCKAGE/HEAT TRANSFER
UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly (LMFBR), 5:33623 (JAPFNR—503)
FLOW BLOCKAGE/HYDRAULICS
UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly (LMFBR), 5:33623 (JAPFNR—503)
FLOW (FLUID)
See FLUID FLOW
FLOWMETERS/PERFORMANCE TESTING
Evaluation of a Coriolis mass flow meter for pulverized coal flows, 5:33745 (DOE/ET/10815—T2)
FLUE GAS/DESULFURIZATION
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
FLUE GAS/HOT GAS CLEANUP
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
FLUID FLOW
See also IDEAL FLOW
LAMINAR FLOW
MULTIPHASE FLOW
TURBULENT FLOW
TWO-PHASE FLOW
FLUID FLOW/HAMILTONIANS
Fluctuation expressions for nonequilibrium distribution functions in adiabatic flows, 5:34267
FLUID MECHANICS
See also AERODYNAMICS
FLUID MECHANICS/INCOMPRESSIBLE FLOW
Vortex simulations of the Rayleigh—Taylor instability, 5:34265
FLUID MECHANICS/LAMINAR FLOW
Vortex simulations of the Rayleigh—Taylor instability, 5:34265
FLUIDIZED-BED COMBUSTION/COMBUSTION PRODUCTS
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
FLUIDIZED-BED COMBUSTION/EFFICIENCY
Atmospheric Fluidized Bed Combustion testing of North Dakota lignite, 5:33237 (CONF-800428—7)
FLUIDIZED-BED COMBUSTION/FLUE GAS
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, October-December 1979, 5:33177 (ANL/CEN/FE—80-4)
FLUIDIZED-BED COMBUSTION/FUNCTIONAL MODELS
Cold slumping characteristics of a fluidized bed, 5:33239 (ORNL/TM—7377)
FLUIDIZED-BED COMBUSTION/MATHEMATICAL MODELS
Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
FLUIDIZED-BED COMBUSTION/PILOT PLANTS
Cold slumping characteristics of a fluidized bed, 5:33239 (ORNL/TM—7377)
FLUIDIZED-BED COMBUSTION/POLLUTION ABATEMENT
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
FLUIDIZED-BED COMBUSTION/RECOMMENDATIONS
Technical planning study: Pressurized Fluidized-Bed Combustion. Final report, 5:33238 (EPRI-CS—1465)
FLUIDIZED-BED COMBUSTION/RESEARCH PROGRAMS
Technical planning study: Pressurized Fluidized-Bed Combustion. Final report, 5:33238 (EPRI-CS—1465)
FLUIDIZED-BED COMBUSTION/TECHNOLOGY ASSESSMENT
Technical planning study: Pressurized Fluidized-Bed Combustion. Final report, 5:33238 (EPRI-CS—1465)
FLUIDIZED-BED COMBUSTORS/DESIGN
Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
FLUIDIZED-BED COMBUSTORS/EROSION
Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
FLUIDIZED-BED COMBUSTORS/MATERIALS
Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)

Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
FLUIDIZED-BED COMBUSTORS/MATERIALS TESTING
Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)
FLUIDIZED-BED COMBUSTORS/METALLOGRAPHY
Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)
FLUIDIZED-BED COMBUSTORS/OPTIMIZATION
Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
FLUIDIZED-BED COMBUSTORS/OXIDATION
Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)
FLUIDIZED-BED COMBUSTORS/RESEARCH PROGRAMS
Chemical Sciences Division, 5:33922 (BNL—50973)
FLUIDIZED-BED COMBUSTORS/SULFIDATION
Materials problems in fluidized-bed combustion systems: effect of process variables on in-bed corrosion. Interim report, 5:34064 (EPRI-CS—1475)
FLUIDS
See also GASES
GEOTHERMAL FLUIDS
HEAT TRANSFER FLUIDS
LIQUIDS
FLUIDS/NATURAL CONVECTION
Combined natural convection and radiation in a volumetrically heated fluid layer, 5:34043
FLUIDS/RADIANT HEAT TRANSFER
Combined natural convection and radiation in a volumetrically heated fluid layer, 5:34043
FLUORINE/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
FLUORINE IONS/ION-ATOM COLLISIONS
Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment (1 MeV/amu), 5:34258
FLY ASH/CHEMICAL COMPOSITION
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLY ASH/CHEMICAL PROPERTIES
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLY ASH/CHLORINATION
High-temperature chlorination of coal fly ash (MS Thesis; 52 references; 750 to 900°C), 5:33223 (IS-T—924)
FLY ASH/MAGNETIC SUSCEPTIBILITY
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLY ASH/MINERALS
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLY ASH/PHYSICAL PROPERTIES
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLY ASH/REDUCTION
High-temperature chlorination of coal fly ash (MS Thesis; 52 references; 750 to 900°C), 5:33223 (IS-T—924)
FLY ASH/WASTE PRODUCT UTILIZATION
Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
High-temperature chlorination of coal fly ash (MS Thesis; 52 references; 750 to 900°C), 5:33223 (IS-T—924)
Power plant fly ash as a resource for alumina and cement, 5:33222 (IS-M—289)
Study of midwestern bituminous coal fly ash (MS Thesis; 74 references), 5:33215 (IS-T—923)
FLYWHEEL ENERGY STORAGE/ECONOMIC ANALYSIS
Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system, 5:33636 (COO—4094-91)
FLYWHEELS/EQUATIONS OF MOTION
Dynamic analysis of a magnetically suspended energy storage wheel, 5:33637 (DOE/ET/20279—102)
FLYWHEELS/PERFORMANCE TESTING
Data analysis techniques used at the Oak Ridge Y-12 Plant Flywheel Evaluation Laboratory, 5:33639 (Y/DX—135)
Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system, 5:33636 (COO—4094-91)
FLYWHEELS/SEALS
Flywheel Seal Test Program, 5:33638 (SAND—80-7019)
FMIT LINAC/BEAM DYNAMICS
Radio-frequency quadrupole: general properties and specific applications, 5:34074 (LA-UR—80-1855)
FMIT LINAC/DESIGN
Fusion Materials Irradiation test facility initial target design, 5:34436 (HEDL-SA—2019-FP)
FMIT LINAC/NEUTRON FLUX
Neutron environment in d + Li facilities, 5:34082 (HEDL-SA—2123-FP)
FMIT LINAC/TARGET CHAMBERS
Fusion Materials Irradiation test facility initial target design, 5:34436 (HEDL-SA—2019-FP)
FOCK METHOD
See HARTREE-FOCK METHOD
FOOD CHAINS/CONTAMINATION
Potential effects of PV-related compounds on food webs, 5:34196 (BNL—51118)
FOOD CHAINS/RADIONUCLIDE MIGRATION
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
FOOD PROCESSING/GEOTHERMAL PROCESS HEAT
Direct application of east coast geothermal resources in a frozen food plant. Final report, 5:33578 (DOE/ET/27228—T1)
FORCED DRAFT COOLING TOWERS
See MECHANICAL DRAFT COOLING TOWERS
FORESTS/ECOLOGY
Verification, validation, and application of detailed forest succession models, 5:34145 (DOE/TIC—11249)
FORESTS/NUTRIENTS
Biomass, energy, and nutrient estimation of mixed southern hardwoods, 5:33435
FORESTS/PLANT GROWTH
Fuels from woody biomass. First annual report, 3 April 1978-2 January 1979, 5:33422 (DOE/ET/20049—T1)
FORESTS/YIELDS
Biomass, energy, and nutrient estimation of mixed southern hardwoods, 5:33435
FORMALDEHYDE/ATOM-MOLECULE COLLISIONS
Reactions with oxygen atoms, 5:33922 (BNL—50973)
FORMATION WATER
See INTERSTITIAL WATER
FORTRAN/PROGRAMMING
BKY Programming Systems Bulletin No. 1. Guidelines for converting FTN4 programs to FTN5 and the new FORTRAN-77 standard. First edition, 5:34447 (LBL—10189/1)
FOSSIL FUELS
See also COAL
NATURAL GAS
OIL SANDS
OIL SHALES
PEAT
PETROLEUM
SHALE OIL
SYNTHETIC FUELS
FOSSIL FUELS/DATA COMPILATION
International energy indicators, 5:33663 (DOE/IA—0010/2)
FOSSIL FUELS/RESEARCH PROGRAMS
University contracts summary book, 5:33171 (DOE/FE—0009)
FOSSIL-FUEL POWER PLANTS
See also ELECTRIC UTILITIES
FOSSIL-FUEL POWER PLANTS/COST
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
FOSSIL-FUEL POWER PLANTS/ENVIRONMENTAL EFFECTS
Panel reports of the first session of the workshop on coal for California, 5:33241 (DOE/ET/12276—T1)
FOSSIL-FUEL POWER PLANTS/MECHANICAL DRAFT COOLING TOWERS
Drift deposition from mechanical draft cooling towers, 5:33589 (PNL-SA—7422)
FOSSIL-FUEL POWER PLANTS/MECHANICAL VIBRATIONS
Air/gas system dynamics of fossil fuel power plants. Volume 2. Mathematical system analysis. Final report, 5:33590 (EPRI-CS—1444(Vol.2))
FOSSIL-FUEL POWER PLANTS/PLUMES
Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
Tracking of smokestack and cooling tower plumes using wind measurements at different levels, 5:34128 (ORNL/TM—7417)
FOSSIL-FUEL POWER PLANTS/POLLUTION CONTROL
Environmental control technologies for a northern California coal-fired power plant, 5:33597 (P—300-80-002)
FOSSIL-FUEL POWER PLANTS/RELIABILITY
Extension and validation of fault-tree analysis for reliability prediction. Final report, 5:33734 (EPRI-AP—1510)

FOUNDRIES/WASTE HEAT UTILIZATION
Industrialised plant growing system, 5:33798
FREDHOLM EQUATION/NUMERICAL SOLUTION
Construction of well-conditioned systems for Fredholm I problems by mesh adapting, 5:34453
FREONS/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
FRESH WATER ECOSYSTEMS
See AQUATIC ECOSYSTEMS
FRESNEL LENS/OPTICS
Linear echelon refractor/reflector solar concentrators, 5:33529
FRICTIONLESS FLOW
See IDEAL FLOW
FUEL ASSEMBLIES/CALORIMETRY
Spent fuel handling and packaging program. Quarterly report, April-June 1980, 5:33309 (DOE/NV/10061—3)
FUEL ASSEMBLIES/FISSION YIELD
Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II (LMFBR), 5:33617 (ENICO—1046)
FUEL ASSEMBLIES/FLOW BLOCKAGE
UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly (LMFBR), 5:33623 (JAPFNR—503)
FUEL ASSEMBLIES/HEAT TRANSFER
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions. Summary report, 5:33621 (IWGFR—29)
FUEL ASSEMBLIES/HYDRAULICS
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions. Summary report, 5:33621 (IWGFR—29)
FUEL ASSEMBLIES/MEETINGS
Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions. Summary report, 5:33621 (IWGFR—29)
FUEL CELL POWER PLANTS/DESIGN
Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979, 5:33752 (DOE/ET/11300—T2)
Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979, 5:33750 (DOE/ET/11300—1)
Cell and stack design alternatives. Fourth quarterly report, May 1, 1979-July 29, 1979, 5:33749 (DOE/ET/11300—)
Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979, 5:33751 (DOE/ET/11300—T1)
Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979, 5:33753 (DOE/ET/11300—T3)
FUEL CELL POWER PLANTS/TOTAL ENERGY SYSTEMS
Cell and stack design alternatives. Second quarterly report, November 1, 1978-January 31, 1979, 5:33752 (DOE/ET/11300—T2)
Cell and stack design alternatives. Final report, August 1, 1978-December 31, 1979, 5:33750 (DOE/ET/11300—1)
Cell and stack design alternatives. Fourth quarterly report, May 1, 1979-July 29, 1979, 5:33749 (DOE/ET/11300—)
Cell and stack design alternatives. Third quarterly report, February 1, 1979-April 30, 1979, 5:33751 (DOE/ET/11300—T1)
Cell and stack design alternatives. Fifth quarterly report, August 1, 1979-October 30, 1979, 5:33753 (DOE/ET/11300—T3)
FUEL COOLING INSTALLATIONS
See SPENT FUEL STORAGE
FUEL CYCLE/PERTURBATION THEORY
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
FUEL FABRICATION PLANTS/COST
Mixed oxide conversion facility alternative conceptual designs (Coprecipitation-direct calcination (COPRECAL)), 5:33306 (AGNS—35900-CONF-71)
FUEL FABRICATION PLANTS/DESIGN
Mixed oxide conversion facility alternative conceptual designs (Coprecipitation-direct calcination (COPRECAL)), 5:33306 (AGNS—35900-CONF-71)
FUEL FABRICATION PLANTS/NUCLEAR MATERIALS MANAGEMENT
Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
FUEL FABRICATION PLANTS/OCCUPATIONAL SAFETY
Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
FUEL FABRICATION PLANTS/SPECIFICATIONS
Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
FUEL OILS
See also HEATING OILS
RESIDUAL FUELS
FUEL OILS/VISCOSITY
Low pour residual fuel compositions (Patent), 5:33277
FUEL PINS/FABRICATION
Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
FUEL REPROCESSING PLANTS/CHEMICAL EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
FUEL REPROCESSING PLANTS/IAEA SAFEGUARDS
Potential for meeting IAEA safeguards goals for reprocessing, 5:33341 (AGNS—35900-Conf-85)
FUEL REPROCESSING PLANTS/RADIOACTIVE EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
FUEL RODS/HEAT TRANSFER
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
FUEL RODS/HYDRAULICS
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
FUEL SPHERES
(Pebble bed reactor fuel elements.)
FUEL SPHERES/FABRICATION
Preparation of thorium-uranium gel spheres, 5:33307 (CONF-800802—12)
FUEL SUBSTITUTION/ENVIRONMENTAL EFFECTS
Environmental assessment of a program to reduce oil and gas consumption by electric utilities, 5:33595 (ANL/EES-TM—97)
FUEL USE ACT
See NATIONAL ENERGY ACT
FUMAROLIC FLUIDS/CHEMICAL COMPOSITION
Characterization of the magmatic and fumarolic gases by their radioactive aerosols, 5:34230
FUMAROLIC FLUIDS/RADIOACTIVITY
Characterization of the magmatic and fumarolic gases by their radioactive aerosols, 5:34230
FUMES
See AEROSOLS
FUNCTION GENERATORS/POWER AMPLIFIERS
Differentially-charged and sequentially-switched square-wave pulse forming network (Patent), 5:34054
FUNDAMENTAL PARTICLES
See ELEMENTARY PARTICLES
FURANS/ABSORPTION SPECTRA
Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan, 5:34246
FURANS/PHOTOIONIZATION
Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan, 5:34246
FURNACES
See also SOLAR FURNACES
FURNACES/AIR POLLUTION CONTROL
Assessment of needs for environmental controls for burning a coal-oil mixture in a slot forge furnace, 5:34123 (IS—4709)
FURNACES/DESIGN
Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace, 5:33852 (HEDL-SA—2189)
FURNACES/ENVIRONMENTAL EFFECTS
Assessment of needs for environmental controls for burning a coal-oil mixture in a slot forge furnace, 5:34123 (IS—4709)
FUSION FUELS
See THERMONUCLEAR FUELS
FUSION REACTORS
See THERMONUCLEAR REACTORS

G

GADOLINIUM 146/ENERGY LEVELS
Decay of ^{146}Tb and the lowest 2^+ state in ^{146}Gd, 5:34332
GADOLINIUM 146/YRAST STATES
Yrast spectra of ^{146}Gd, ^{147}Gd and ^{152}Dy in the deformed independent particle model, 5:34330 (ANL/PHY—79-4)
GADOLINIUM 147/YRAST STATES
Yrast spectra of ^{146}Gd, ^{147}Gd and ^{152}Dy in the deformed independent particle model, 5:34330 (ANL/PHY—79-4)

GAGES (STRAIN)
See STRAIN GAGES
GALAXIES/ORIGIN
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
GALLIUM/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
GALLIUM 71 TARGET/LITHIUM 7 REACTIONS
High-spin states and band structure in ^{76}Se, 5:34327
GALLIUM ARSENIDES/CHEMICAL VAPOR DEPOSITION
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
GALLIUM ARSENIDES/CORROSION RESISTANCE
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
GALLIUM ARSENIDES/ELECTROPLATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
GALLIUM ARSENIDES/SURFACE PROPERTIES
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
GAMMA RADIATION/RADIATION INJURIES
Distinction between the roles of O_2 and of O^-_2 in biological radiodamage, 5:34184 (DOE/EV/03221—68)
GAS CENTRIFUGES/GAS FLOW
Gas flow in a centrifuge, 5:33347 (K/OA—4748)
GAS COOLANTS
See GASES
GAS COOLED FAST BREEDER REACTOR
See GCFR REACTOR
GAS ENGINES
See INTERNAL COMBUSTION ENGINES
GAS HYDRATES
Methane hydrate as an energy resource. A review with recommended future research, 5:33280 (LA—8368-MS)
GAS INJECTION/GAS GENERATORS
Process and system for recovering hydrocarbons from underground formations (Patent), 5:33250
GAS LASERS/ELECTRIC DISCHARGES
Investigation of the production of high density uniform plasmas. Volume I. Final report, 2 April 1978-2 April 1979, 5:34027 (AD-A—076492)
GAS LASERS/EXCITATION
Investigation of surface-stabilized high-pressure gas discharges. Final report, 22 May 1978-21 May 1979, 5:34029 (AD-A—077040)
GAS OILS/THERMAL CRACKING
Thermal cracking of gas oil to middle distillate, 5:33261
GAS TURBINE ENGINES/FUEL SUBSTITUTION
Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand, 5:33846 (CONF-790520—)
GAS TURBINE ENGINES/REGENERATORS
Regenerator matrix physical property data, 5:33821 (DOE/NASA/0008—80/11)
GAS TURBINES/DEMONSTRATION PROGRAMS
Advanced industrial gas turbine technology readiness demonstration. Quarterly technical progress report No. 12, 1 December 1979-29 February 1980, 5:33795 (DOE/OR/05035—T1)
GAS TURBINES/EROSION
Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
GAS TURBINES/MATERIALS
Materials problems in fluidized-bed combustion systems: review of the information on gas turbine materials in coal combustion environments, 5:34063 (EPRI-CS—1469)
GAS TURBINES/TECHNOLOGY ASSESSMENT
Advanced industrial gas turbine technology readiness demonstration. Quarterly technical progress report No. 12, 1 December 1979-29 February 1980, 5:33795 (DOE/OR/05035—T1)
GASES
See also NATURAL GAS
SYNTHESIS GAS
VOLCANIC GASES
GASES/DIELECTRIC PROPERTIES
High voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, October 1, 1979-March 31, 1980, 5:34238 (ORNL/TM—7405)
GASES/MASS BALANCE
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
GASES/PHOTON TRANSPORT
Influence of propagation on off-resonant molecular excitation, 5:34365 (UCRL—84259(Rev.1))
GASES/QUANTITATIVE CHEMICAL ANALYSIS
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
GASES/SCAVENGING
Gas and aerosol scavenging, 5:34130 (PNL-SA—8170)
GASES/WAVE PROPAGATION
Influence of propagation on off-resonant molecular excitation, 5:34365 (UCRL—84259(Rev.1))
GASIFICATION
See also COAL GASIFICATION
GASIFICATION/TECHNOLOGY TRANSFER
Production of methanol from wood, 5:33363 (CONF-790520—)
GAS-INSULATED CABLES/BREAKDOWN
Superposition gas breakdown. Final report, 5:33601 (EPRI-EL—1484)
GAS-INSULATED CABLES/OPERATING COST
High-temperature gas-insulated systems. Final report, 5:33605 (EPRI-EL—1500)
GAS-INSULATED CABLES/PERFORMANCE TESTING
High-temperature gas-insulated systems. Final report, 5:33605 (EPRI-EL—1500)
GASOHOL/COMBUSTION PRODUCTS
Characterization of alcohol/gasoline blends as a stratified-charge engine fuel: performance and emissions, 5:33848 (CONF-790520—)
GASOHOL/COMMERCIALIZATION
Alcohol/gasoline reliability fleet tests: a US Federal project, 5:33842 (CONF-790520—)
Alternative transportation fuels, 5:33849 (CONF-800419—5)
GASOHOL/COMPARATIVE EVALUATIONS
Ethanol/gasoline blends as automotive fuels, 5:33840 (CONF-790520—)
GASOHOL/ECONOMICS
Gasohol, 5:33430 (OTA-TM-E—1)
GASOHOL/FINANCIAL INCENTIVES
Legal and regulatory influences on alcohol fuels use in the United States, 5:33417 (CONF-790520—)
GASOHOL/LEGAL INCENTIVES
Legal and regulatory influences on alcohol fuels use in the United States, 5:33417 (CONF-790520—)
GASOHOL/PERFORMANCE
Gasohol, 5:33430 (OTA-TM-E—1)
GASOHOL/PERFORMANCE TESTING
50,000 mile methanol/gasoline blend fleet study: a progress report, 5:33841 (CONF-790520—)
Alcohol/gasoline reliability fleet tests: a US Federal project, 5:33842 (CONF-790520—)
Characterization of alcohol/gasoline blends as a stratified-charge engine fuel: performance and emissions, 5:33848 (CONF-790520—)
Ethanol/gasoline blends as automotive fuels, 5:33840 (CONF-790520—)
GASOHOL/PHYSICAL PROPERTIES
Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—)
GASOHOL/TECHNOLOGY ASSESSMENT
Gasohol, 5:33430 (OTA-TM-E—1)
GASOLINE/CATALYTIC REFORMING
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
GASOLINE/COMPARATIVE EVALUATIONS
Driving cycle comparisons of energy economies and emissions from an alcohol and gasoline fueled vehicle, 5:33844 (CONF-790520—)
Ethanol/gasoline blends as automotive fuels, 5:33840 (CONF-790520—)
GASTEROPODS
See MOLLUSCS
GCFR REACTOR/PRIMARY COOLANT CIRCUITS
US GCFR demonstration plant design, 5:33618 (GA-A—15932)
GCFR REACTOR/REACTOR CORES
US GCFR demonstration plant design, 5:33618 (GA-A—15932)
GCFR REACTOR/STEAM SYSTEMS
US GCFR demonstration plant design, 5:33618 (GA-A—15932)
GE SEMICONDUCTOR DETECTORS/CALIBRATION STANDARDS
Germanium semiconductor detector efficiency determination using a standard Marinelli (reentrant) beaker geometry, 5:34091
GEIGER-MUELLER COUNTERS/COUNTING CIRCUITS
Compensated count rate circuit for portable Geiger-Mueller survey meter, 5:34089
GENERATORS (ELECTRIC)
See ELECTRIC GENERATORS
GENERATORS (STEAM)
See STEAM GENERATORS

GEOCHEMICAL SURVEYS/DATA ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
GEOCHEMISTRY/COMPUTER CODES
Computer plotting of geochemical data in plain view (PLANMAP.REV1 user's guide), 5:33561 (DOE/ID/12079—3)
Computer plotting of drill hole geochemical data (SECTION.Rev 1 user's guide), 5:33562 (DOE/ID/12079—6)
GEOLOGIC FORMATIONS/DEFORMATION
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
GEOLOGIC FORMATIONS/DISPLACEMENT RATES
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
GEOLOGIC FORMATIONS/STRESSES
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
GEOLOGIC STRUCTURES/CREEP
Finite element modeling of long-term fluid-structure interaction problems in geological media, 5:34225 (LA-UR—79-3016)
GEOPRESSURED SYSTEMS/ENERGY SOURCE DEVELOPMENT
Future role of geopressured resources in US energy policy: a scenario approach and analysis. Final report, July 1, 1978-March 31, 1979, 5:33286 (COO—4955-1)
GEORGIA/ACID RAIN
Rainfall element content and acidity from April 30, 1976 to February 17, 1978, Athens, Georgia, 5:34117 (DOE/EV/00641—42)
GEORGIA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
GEOTHERMAL ENERGY/ENERGY SOURCE DEVELOPMENT
Regulation of geothermal energy development in Colorado, 5:33566 (DOE/ID/12018—2)
GEOTHERMAL ENERGY/INFORMATION SYSTEMS
Feasibility study for establishing a centralized geothermal data base for New Mexico. Final report, June 1, 1979-October 15, 1979, 5:33547 (NMEI—50)
GEOTHERMAL ENERGY/LEGISLATION
Regulation of geothermal energy development in Colorado, 5:33566 (DOE/ID/12018—2)
GEOTHERMAL ENERGY/MEETINGS
Geothermal resources for aquaculture. Proceedings of a workshop, Boise, Idaho, December 13-15, 1977, 5:33548 (ORESU-W—78-001)
GEOTHERMAL ENERGY/REGULATIONS
Regulation of geothermal energy development in Colorado, 5:33566 (DOE/ID/12018—2)
GEOTHERMAL EXPLORATION/LEADING ABSTRACT
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
GEOTHERMAL FLUIDS
See also FUMAROLIC FLUIDS
GEOTHERMAL FLUIDS/CHEMICAL ANALYSIS
Development of the high-temperature redox electrode. Interim report ending March 1980, 5:33564 (PNL—3377)
GEOTHERMAL FLUIDS/CHEMICAL COMPOSITION
Moderate temperature geothermal: a direct source of process energy, 5:33577 (CONF-801014—1)
GEOTHERMAL FLUIDS/CORROSIVE EFFECTS
Localized corrosion of steels in geothermal steam/brine mixtures, 5:33575 (UCRL—84489)
GEOTHERMAL FLUIDS/WATER TREATMENT
Removal of silica from Raft River geothermal water, 5:33570 (EGG-FM—5170)
GEOTHERMAL POWER PLANTS/COOLING
Removal of silica from Raft River geothermal water, 5:33570 (EGG-FM—5170)
GEOTHERMAL POWER PLANTS/PERFORMANCE TESTING
Test results from the 500 kW direct contact pilot plant at East Mesa, 5:33569 (LBL—11107)
GEOTHERMAL POWER PLANTS/SURVEYS
Geothermal energy as a source of electricity. A worldwide survey of the design and operation of geothermal power plants (Book), 5:33568 (DOE/RA/28320—1)
GEOTHERMAL PROCESS HEAT/FEASIBILITY STUDIES
Direct application of east coast geothermal resources in a frozen food plant. Final report, 5:33578 (DOE/ET/27228—T1)
Moderate temperature geothermal: a direct source of process energy, 5:33577 (CONF-801014—1)
GEOTHERMAL RESOURCES/RESOURCE ASSESSMENT
Geothermal energy: overview, 5:33549 (ORESU-W—78-001)
GEOTHERMAL RESOURCES/USES
Geothermal energy: overview, 5:33549 (ORESU-W—78-001)
GEOTHERMAL SPACE HEATING/COMPUTER CODES
User manual for geothermal energy assisted dairy complex computer programs: PREBLD, MODEL0, MODEL1, MODEL2, FRMAT2, PREPI2, NET2, DAIRY and DAIRY1, 5:33581 (DOE/ET/28434—T1)
GEOTHERMAL SPACE HEATING/SIMULATION
User manual for geothermal energy assisted dairy complex computer programs: PREBLD, MODEL0, MODEL1, MODEL2, FRMAT2, PREPI2, NET2, DAIRY and DAIRY1, 5:33581 (DOE/ET/28434—T1)
GEOTHERMAL SYSTEMS
See also GEOPRESSURED SYSTEMS
HOT-WATER SYSTEMS
GEOTHERMAL SYSTEMS/HYDRAULIC FRACTURING
Interactive fracture design model, 5:33576 (DOE/AL/10563—T4)
GEOTHERMAL WELLS/CEMENTS
Process Sciences Division, 5:33574 (BNL—50973)
GEOTHERMAL WELLS/DRILLING EQUIPMENT
Laboratory and field testing of improved geothermal rock bits, 5:33573 (SAND—80-7102)
Seal/lubricant systems for geothermal drilling equipment, 5:33572 (SAND—80-7101)
GEOTHERMAL WELLS/MATERIALS TESTING
Process Sciences Division, 5:33574 (BNL—50973)
GEOTHERMAL WELLS/MONITORING
High temperature hybrids for use up to 275°C - drift and lifetime, 5:33565 (SAND—80-0444C)
GEOTHERMAL WELLS/PERMITS
Drilling for geothermal resources: rules and regulations and minimum well construction standards, 5:33567
GEOTHERMAL WELLS/REGULATIONS
Drilling for geothermal resources: rules and regulations and minimum well construction standards, 5:33567
GERMANIUM/ANNEALING
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
GERMANIUM/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
GERMANIUM/CRYSTAL STRUCTURE
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
GERMANIUM/LASER-RADIATION HEATING
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
GERMANIUM/MUONIUM
Review of the experimental results on impurity centers in elemental semiconductors obtained by μSR and other techniques, 5:34255 (LA-UR—80-2377)
GERMANIUM/PHOTOCONDUCTIVITY
Donor complex with tunneling hydrogen in pure germanium, 5:33880
GERMANIUM/STRESSES
Donor complex with tunneling hydrogen in pure germanium, 5:33880
GERMANIUM/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
GERMANIUM ALLOYS/SUPERCONDUCTIVITY
LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980, 5:34379 (LA—8446-PR)
GERMANIUM COMPOUNDS/SPUTTERING
Surfaces of high-T/sub c/ Nb_3Ge films as studied by electron tunneling and auger electron spectroscopy, 5:34009
GERMANIUM DETECTORS
See GE SEMICONDUCTOR DETECTORS
GERMANY (FEDERAL REPUBLIC)
See FEDERAL REPUBLIC OF GERMANY
GETTERS/MATERIALS TESTING
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
GHANA/ENERGY CONSUMPTION
Energy consumption: case of the Ivory Coast, Senegal and Ghana (Electricity and gasoline), 5:33743
GLASS/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes, 5:33316 (DOE/TIC—11219)
GLASS/CRACKS
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
GLASS/CRYSTAL STRUCTURE
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)

Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
GLASS/F CENTERS
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
GLASS/FABRICATION
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
GLASS/LIGHT SCATTERING
Specularity measurements for solar materials, 5:33538
GLASS/OPTICAL PROPERTIES
Specularity measurements for solar materials, 5:33538
GLASS/PHYSICAL PROPERTIES
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
GLASS/RECYCLING
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
GLAZING MATERIALS/LIGHT SCATTERING
Specularity measurements for solar materials, 5:33538
GLAZING MATERIALS/OPTICAL PROPERTIES
Specularity measurements for solar materials, 5:33538
GLIOBLASTOMAS
See NEOPLASMS
GLUONS/COUPLING
Possibility of detecting triple gluon coupling and Adler-Bell-Jackiw anomaly in polarized deep inelastic scattering, 5:34294 (SLAC-PUB—2505)
GLYCOLS/CORROSIVE EFFECTS
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
GLYCOLS/DECOMPOSITION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Determination of interaction between different waters and chemical antifreeze additives. Task 3 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33515 (DOE/CS/10510—T10)
GOLD/ELECTRONIC STRUCTURE
Angle-resolved photoemission determination of Λ-line valence bands in Pt and Au using synchrotron radiation, 5:33877
GOLD/LIGHT TRANSMISSION
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
GOLD/PHOTOELECTRON SPECTROSCOPY
Angle-resolved photoemission determination of Λ-line valence bands in Pt and Au using synchrotron radiation, 5:33877
GOLD/SPECTRAL REFLECTANCE
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
GOLD/SURFACE COATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
GOLD/VOLTAMETRY
Comparison assay of a gold plating solution by controlled-potential coulometry and fire assay, 5:33923 (UCID—18766)
GOLD 197 TARGET/ARGON 40 REACTIONS
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
GRAIN BOUNDARIES/VACANCIES
Simulation of the structure of vacancies in high angle grain boundaries, 5:33855
GRANITES/MECHANICAL PROPERTIES
Status of LLNL granite projects, 5:33338 (UCRL—84613)
GRANITES/RADIONUCLIDE MIGRATION
Status of LLNL granite projects, 5:33338 (UCRL—84613)
GRANITES/THERMODYNAMICS
Status of LLNL granite projects, 5:33338 (UCRL—84613)
GRANULAR BED FILTERS/MATERIALS
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, April-June 1980, 5:33236 (ANL/CEN/FE—80-6)
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
GRANULAR BED FILTERS/PRESSURE DROP
Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1980, 5:33235 (ANL/CEN/FE—80-5)
GRASS/ENERGY SOURCE DEVELOPMENT
Energy from biological processes, 5:33429 (OTA-E—124)
GRASS/PLANT BREEDING
Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Annual progress report, November 1, 1979 to October 31, 1980, 5:34181 (DOE/EV/00637—9)
GREAT BRITAIN
See UNITED KINGDOM
GREENHOUSES
See also ATTACHED GREENHOUSES
GREENHOUSES/DESIGN
Industrialised plant growing system, 5:33798
GREENHOUSES/WASTE HEAT UTILIZATION
Industrialised plant growing system, 5:33798
GROSS DOMESTIC PRODUCT/ENERGY CONSUMPTION
Trends in energy use in industrial societies. Final report, 5:33742 (EPRI-EA—1471)
GROSS NATIONAL PRODUCT/ENERGY CONSUMPTION
International energy indicators, 5:33663 (DOE/IA—0010/2)
GROUND WATER
See also INTERSTITIAL WATER
GROUND WATER/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
GROUND WATER/FLUID FLOW
Physical aspects of the interface between the saturated and the unsaturated regimes, 5:34220 (LBL—11178)
GROUND WATER/RADIONUCLIDE MIGRATION
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
GROUND WATER/WATER POLLUTION
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
GULF GENERAL ATOMIC FAST BREEDER REACTOR
See GCFR REACTOR
GYPSUM CEMENTS/DRYING
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))
GYROSCOPES/READOUT SYSTEMS
Development of a London moment readout for a superconducting gyroscope, 5:33976
GYROSCOPES/SQUID DEVICES
Development of a London moment readout for a superconducting gyroscope, 5:33976

H

HADRON REACTIONS/LECTURES
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
HADRON REACTIONS/MULTIPLE PRODUCTION
Quark model and high-energy nuclear experiments, 5:34356 (LBL—8957)
HADRON REACTIONS/NUCLEAR MODELS
Critical analysis of models for high-energy hadron-nucleus interactions, 5:34363 (LBL—8957)
HADRON REACTIONS/PARTICLE PRODUCTION
Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957)
HADRONS
See also BARYONS
MESONS
HADRONS/PAIR PRODUCTION
Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957)
HADRONS/PARTICLE MODELS
Vacuum structure and QCD, 5:34303 (LBL—8957)
HAFNIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
HAFNIUM OXIDES/SURFACE COATING
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
HALL GENERATORS
See MHD GENERATORS
HALOGENS/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
HANFORD RESERVATION/PERSONNEL
Continuing study of mortality in Hanford workers, 5:34187 (PNL-SA—8106)
Mortality of Hanford radiation workers, 5:34188 (PNL-SA—8110)

HARD COAL
See ANTHRACITE
HARD COLLISION MODELS
Nonperturbative vacuum and hard scattering processes, 5:34301 (FERMILAB-CONF—80/68-THY)
HARTREE-FOCK METHOD/CURRENT DENSITY
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
HASTELLOY X/CORROSION PROTECTION
Investigation of several commercial aluminide coatings for carburization protection of a nickel-base alloy, 5:33886 (GA-A—15825)
HASTELLOY X/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
HASTELLOY X/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
HASTELLOY X/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
HAWAII/ENERGY CONSERVATION
Energy self-sufficiency for the County of Kauai. Volume 2. General energy plan, 5:33699 (HNEI—80-04)
HAWAII/ENERGY SUPPLIES
Energy self-sufficiency for the County of Kauai. Volume 2. General energy plan, 5:33699 (HNEI—80-04)
HAWAII/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
HAWAII/RENEWABLE ENERGY SOURCES
Energy self-sufficiency for the County of Kauai. Volume 2. General energy plan, 5:33699 (HNEI—80-04)
HD 8077
See NICKEL BASE ALLOYS
HD-556
See ALLOY-HD-556
HEALTH HAZARDS
Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
HEAT EXCHANGERS
See also HEAT PUMPS
HEAT EXCHANGERS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
HEAT EXCHANGERS/BIOLOGICAL FOULING
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)
HEAT EXCHANGERS/PERFORMANCE
Parametric analysis of the performance of internally finned tubes for heat exchanger application, 5:34041
HEAT EXCHANGERS/PERFORMANCE TESTING
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)
HEAT EXCHANGERS/TUBES
Parametric analysis of the performance of internally finned tubes for heat exchanger application, 5:34041
HEAT PIPES/BIBLIOGRAPHIES
Heat pipe technology: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33956 (TAC-HP—80-001)
HEAT PUMPS
See also CHEMICAL HEAT PUMPS
SOLAR-ASSISTED HEAT PUMPS
HEAT PUMPS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
HEAT RECOVERY EQUIPMENT/FEASIBILITY STUDIES
Assessment of the potential for heat recovery and load leveling on refrigeration systems Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
HEAT RECOVERY EQUIPMENT/PERFORMANCE
Useful heat from waste heat, 5:33799 (NP—24997)
HEAT STORAGE
See also LATENT HEAT STORAGE
THERMOCHEMICAL HEAT STORAGE
Description of the thermal and thermochemical energy storage program, 5:33642 (DOE/JPL—1060-12(Vol.2))
Need for specific requirements by storage system development teams, 5:33544 (DOE/JPL—1060-12(Vol.2))
HEAT STORAGE/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
HEAT STORAGE/MEETINGS
Thermal storage applications workshop held at Golden, Colorado, February 14-15, 1978. Volume II. Contributed papers, 5:33540 (DOE/JPL—1060-12(Vol.2))
Thermal storage applications workshop. Volume 1. Plenary session analysis, 5:33539 (DOE/JPL—1060-12(Vol.1))
HEAT TRANSFER
See also CONVECTION
RADIANT HEAT TRANSFER
THERMAL CONDUCTION
HEAT TRANSFER/MATHEMATICAL MODELS
Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste, 5:33334 (SAND—80-0312C)
HEAT TRANSFER/MONTE CARLO METHOD
Monte Carlo method of solving heat conduction problems, 5:34044
HEAT TRANSFER FLUIDS/CORROSIVE EFFECTS
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Review of state-of-the-art of solar collector corrosion processes. Task 1 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33517 (DOE/CS/10510—T12)
HEAT TRANSFER FLUIDS/DECOMPOSITION
Determination of interaction between different waters and chemical antifreeze additives. Task 3 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33515 (DOE/CS/10510—T10)
HEAT TRANSMISSION
See HEAT TRANSFER
HEATING LOAD/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
HEATING OILS/COST
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
HEATING SYSTEMS
See also SOLAR HEATING SYSTEMS
HEATING SYSTEMS/CONVERSION
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
HEATING SYSTEMS/ECONOMIC ANALYSIS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
HEATING SYSTEMS/ENERGY EFFICIENCY
Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978, 5:33773 (BNL—51171)
HEATING SYSTEMS/ENERGY STORAGE
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)
HEAVY ION REACTIONS
See also ARGON 40 REACTIONS
BORON 11 REACTIONS
CALCIUM 40 REACTIONS
CARBON 12 REACTIONS
CARBON 13 REACTIONS
DEEP INELASTIC HEAVY ION REACTIONS
LEAD 208 REACTIONS
LITHIUM 6 REACTIONS
LITHIUM 7 REACTIONS
NEON 20 REACTIONS
NITROGEN 15 REACTIONS
HEAVY ION REACTIONS/EQUATIONS OF MOTION
Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361
HEAVY ION REACTIONS/MEETINGS
First workshop on ultra-relativistic nuclear collisions (LBL, May 21-24, 1979), 5:34355 (LBL—8957)
HEAVY ION REACTIONS/MULTIPLE PRODUCTION
Quark model and high-energy nuclear experiments, 5:34356 (LBL—8957)
HEAVY ION REACTIONS/NUCLEAR REACTION KINETICS
Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions, 5:34358 (LBL—8957)
Nuclear physics perspectives on high-energy nuclear collisions, 5:34357 (LBL—8957)
HEAVY ION REACTIONS/PARTICLE PRODUCTION
Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957)
HEAVY WATER/PURIFICATION
Extraction method of tritium (Patent), 5:33933
HEAVY WATER COOLANT
See HEAVY WATER

HECTORITE
See MONTMORILLONITE
HELIOS FACILITY/LASER IMPLOSIONS
One-dimensional computer simulations of exploding pusher targets for the Los Alamos Helios laser system, 5:34421 (LA—8458-MS)
HELIOSTATS/SOLAR TRACKING
Open-loop heliostat reflector, 5:33522 (UCID—18764)
HELIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
HELIUM/AUTOIONIZATION
Measured cross sections for the photoionization of ground state He to He^+ (n=2), 5:34248
HELIUM/CORROSIVE EFFECTS
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
HELIUM/ELECTRON-ATOM COLLISIONS
Large-momentum-transfer limit of some matrix elements, 5:34261
HELIUM/MASS SPECTROSCOPY
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
HELIUM/PHOTOIONIZATION
Measured cross sections for the photoionization of ground state He to He^+ (n=2), 5:34248
HELIUM/WAVE FUNCTIONS
Large-momentum-transfer limit of some matrix elements, 5:34261
HELIUM 3 REACTIONS/ELASTIC SCATTERING
Analysis of $^3He + {}^4He$ elastic scattering between 18 and 70 MeV with the resonating group method of Brown and Tang, 5:34316
Nucleus-nucleus total reaction cross sections, 5:34317
HELIUM 3 REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
HELIUM 3 TARGET/PHOTONUCLEAR REACTIONS
Measurement of $p+d \rightarrow {}^3He+\gamma$ and comparison with the inverse reaction, 5:34315
HELIUM 3 TARGET/PROTON REACTIONS
Differential cross sections for $p + {}^3He$ scattering from 19.5 to 47.5 MeV, 5:34313 (LA—8179-MS)
HELIUM 4 TARGET/HELIUM 3 REACTIONS
Analysis of $^3He + {}^4He$ elastic scattering between 18 and 70 MeV with the resonating group method of Brown and Tang, 5:34316
HELIUM IONS/ION SOURCES
High current source of He^- ions, 5:34077
HEMATOPOIESIS
See BLOOD FORMATION
HEMOGLOBIN/GENETICS
Expression of embryonic hemoglobin genes in α-thalassemic and in β-duplication mice, 5:34228 (CONF-7905172—1)
HEMOPOIESIS
See BLOOD FORMATION
HETERODYNE RECEIVERS/JOSEPHSON JUNCTIONS
Differential heterodyne frequency conversion at 0.4 mm wavelength, 5:33990
Josephson mixers at submillimetre wavelengths: present experimental status and future developments, 5:33986
Mixing with Josephson junctions in the far infrared, 5:33987
Progress on millimeter wave Josephson junction mixers, 5:34019
HETERODYNE RECEIVERS/PERFORMANCE
Josephson mixers at submillimetre wavelengths: present experimental status and future developments, 5:33986
HIGH BTU GAS
See also SNG PLANTS
HIGH BTU GAS/COMMERCIALIZATION
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
HIGH BTU GAS/COMPARATIVE EVALUATIONS
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
HIGH BTU GAS/ECONOMIC ANALYSIS
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
HIGH ENERGY PHYSICS/PLANNING
High Energy Physics Advisory Panel. A report of the 1980 Subpanel on review and planning for the US High Energy Physics Program, 5:34269 (DOE/ER—0066)
HIGH ENERGY PHYSICS/RESEARCH PROGRAMS
Medium-energy physics program. Progress report, February 1-April 30, 1979 (LAMPF), 5:34066 (LA—8257-PR)
Research highlights for the period February 1, 1980-July 31, 1980 (Joseph Henry Labs., Dept. of Physics, Princeton Univ.), 5:34268 (DOE/ER/03072—T2)
HIGH ENERGY PHYSICS/SOCIOLOGY
Critical review of a quantitative study of a specialty in high energy particle physics, 5:34392 (BNL—28145)
HIGH EXPLOSIVES
See CHEMICAL EXPLOSIVES
HIGH-FREQUENCY HEATING/COMPUTER CODES
GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array, 5:34393 (ANL/FPP/TM—135)
HIGH-FREQUENCY HEATING/MEETINGS
Report of the workshop on rf heating in mirror systems, 5:34394 (DOE/ER—0070)
HIGH-LEVEL RADIOACTIVE WASTES/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
HIGH-TEMPERATURE GAS-COOLED REACTOR
See HTGR TYPE REACTORS
HK 40
See ALLOY-HK-40
HOG FUEL
See WOOD WASTES
HOLMIUM 165/ELECTRON REACTIONS
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
HONEYCOMB STRUCTURES/MAPS
Free convection heat transfer across rectangular-celled diathermanous honeycombs, 5:34042
HONEYCOMB STRUCTURES/NATURAL CONVECTION
Free convection heat transfer across rectangular-celled diathermanous honeycombs, 5:34042
HOSPITALS/ENERGY CONSERVATION
Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries., 5:33786
HOT-WATER SYSTEMS/COMPUTERIZED SIMULATION
Modification and implementation of the M.E.T.C. SIMPAC program, 5:33550 (DOE/AL/10563—T5)
HOUSEHOLDS/ENERGY DEMAND
Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16, 5:33777 (Juel-Spez—64)
HOUSEHOLDS/SPACE HEATING
Regional structure of the heat demand of the household and commercial sector in the Federal Republic of Germany. Applied Systems Analysis report No. 16, 5:33777 (Juel-Spez—64)
HOUSES/AIR CONDITIONING
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
HOUSES/AIR INFILTRATION
Air infiltration measurement techniques, 5:33780 (LBL—10705)
HOUSES/ENERGY CONSERVATION
Energy and labor implication of improving thermal integrity of new houses. Final report, 5:33692 (DOE/CS/20258—2)
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
HOUSES/ENERGY CONSUMPTION
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
Basic principles of heat loss and energy consumption in a house. Publication ECR No. 1, 5:33783
Social factors affecting energy use and conservation in the home, 5:33772 (AES—1/80)
HOUSES/ENERGY DEMAND
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
HOUSES/HEAT LOSSES
Basic principles of heat loss and energy consumption in a house. Publication ECR No. 1. 5:33783
HOUSES/INDOOR AIR POLLUTION
Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
HOUSES/RETROFITTING
Criteria for retrofit materials and products for weatherization of residences, 5:33781 (NBS-TN—982)
HOUSES/SOLAR SPACE HEATING
Hodges residence: performance of a direct gain passive solar home in the 1979-1980 heating season, 5:33474 (IS-M—290)
Preliminary designs: passive solar manufactured housing. Technical status report, 5:33463 (DOE/CS/30377—1)
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia, 5:33469 (DOE/NASA/CR—161507)

Solar project description for Design Construction Association single family dwelling, Big Fork, Montana, 5:33488 (SOLAR/1029—80/50)
Solar project description for Moulder Corporation single family residence, Greenwood, Indiana, 5:33485 (SOLAR/1001—80/50)
Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland, 5:33486 (SOLAR/1012—80/50)

HOUSES/SOLAR WATER HEATING
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia, 5:33469 (DOE/NASA/CR—161507)
Solar project description for Design Construction Association single family dwelling, Big Fork, Montana, 5:33488 (SOLAR/1029—80/50)
Solar project description for Moulder Corporation single family residence, Greenwood, Indiana, 5:33485 (SOLAR/1001—80/50)
Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland, 5:33486 (SOLAR/1012—80/50)

HOUSES/SPACE HEATING
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)

HOUSES/THERMAL INSULATION
Energy and labor implication of improving thermal integrity of new houses. Final report, 5:33692 (DOE/CS/20258—2)

HOUSES/WEATHERIZATION
Criteria for retrofit materials and products for weatherization of residences, 5:33781 (NBS-TN—982)

HTGR TYPE REACTORS/FISSION PRODUCTS
US/FRG Umbrella Agreement for Cooperation in GCR Development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, April 1, 1980-June 1, 1980, 5:33613 (GA-A—15942)

HTGR TYPE REACTORS/FUEL ELEMENTS
US/FRG Umbrella Agreement for Cooperation in GCR Development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, April 1, 1980-June 1, 1980, 5:33613 (GA-A—15942)

HTGR TYPE REACTORS/GRAPHITE
US/FRG Umbrella Agreement for Cooperation in GCR Development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, April 1, 1980-June 1, 1980, 5:33613 (GA-A—15942)

HTGR TYPE REACTORS/REACTOR MATERIALS
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)

HUMAN CELLS
See ANIMAL CELLS

HVAC SYSTEMS/ELECTRIC CABLES
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)

HVAC SYSTEMS/OIL-FILLED CABLES
Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979, 5:33602 (CONS—3122-T2)

HVDC SYSTEMS/RESEARCH PROGRAMS
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, April 1, 1980-June 30, 1980, 5:33608 (DOE/ET/29185—17)

HYBRID ELECTRIC-POWERED VEHICLES/CERTIFICATION
Electric and hybrid vehicle self-certification and verification procedures: Market Demonstration Program, 5:33834 (DOE/CS—0178(Rev.1))

HYBRID ELECTRIC-POWERED VEHICLES/COST
Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)

HYBRID ELECTRIC-POWERED VEHICLES/MATERIAL SUBSTITUTION
Mass-reduction effort of the electric and hybrid vehicle, 5:33835 (DOE/JPL/955283—1)

HYBRID ELECTRIC-POWERED VEHICLES/OPERATION
Selection of power ratios in the electrical equipment of an electric automobile with combination-type power plant, 5:33837 (DOE-tr—236)

HYDRAULIC FRACTURING/COMPUTER CODES
Interactive fracture design model, 5:33576 (DOE/AL/10563—T4)

HYDRAULIC FRACTURING/DEMONSTRATION PROGRAMS
Western Gas Sands Project. Status report, 1 May-31 May, 1980, 5:33285 (DOE/BC/10003—10)

HYDRAULIC FRACTURING/MATHEMATICAL MODELS
Interactive fracture design model, 5:33576 (DOE/AL/10563—T4)

HYDRAULIC TRANSPORT/TEST FACILITIES
Separate effects test stand for obtaining hydrotransport data, 5:33233 (PNL—3468)

HYDRIDATION/KINETICS
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)

HYDRIDATION/MATHEMATICAL MODELS
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)

HYDRIDES/RESEARCH PROGRAMS
Chemical Sciences Division, 5:33922 (BNL—50973)

HYDROCARBON LOGGING
See WELL LOGGING

HYDROCARBONS
See also ALKANES
ALKENES
POLYCYCLIC AROMATIC HYDROCARBONS

HYDROCARBONS/AIR POLLUTION CONTROL
Gas phase oxidation downstream of a catalytic combustor, 5:33839 (DOE/NASA/1040—16)

HYDROCARBONS/CATALYTIC CRACKING
Hydrocarbon cracking catalyst (Patent), 5:33255
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
Sulfur oxides control in catalytic cracking (Patent), 5:33272

HYDROCARBONS/CATALYTIC REFORMING
Combination process for selected aromatic hydrocarbon production (Patent), 5:33263
Process for the simultaneous production of aromatic hydrocarbons and isobutane (Patent), 5:33262

HYDROCARBONS/CRACKING
Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas (Patent), 5:33356

HYDROCARBONS/DEHYDROGENATION
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259

HYDROCARBONS/DESULFURIZATION
Cobalt-molybdenum-alumina desulfurization catalyst (Patent), 5:33254

HYDROCARBONS/HYDROCRACKING
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Process for the simultaneous production of aromatic hydrocarbons and isobutane (Patent), 5:33262
Selective hydrocracking process for middle distillate (Patent), 5:33252

HYDROCARBONS/HYDROGENATION
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259

HYDROCARBONS/YIELDS
Hydrocarbon production from arid land plant species, 5:33413

HYDROCHLORIC ACID/CHEMICAL REACTIONS
Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932

HYDROCHLORIC ACID/DE-EXCITATION
Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932

HYDROCHLORIC ACID/INTERATOMIC FORCES
Valence bond diatomics-in-molecules (DIM) treatment of collinear interactions of Group IIa and IIb metal atoms with hydrogen halides: Application to the CaHCl system, 5:34239

HYDROCHLORIC ACID/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)

HYDROCRACKING
See also CATALYTIC CRACKING

HYDROCRACKING/CATALYSTS
Development of a simulated catalyst aging technique, 5:33264
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal, 5:33209
Selective hydrocracking process for middle distillate (Patent), 5:33252

HYDROELECTRIC POWER/FINANCIAL INCENTIVES
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
HYDROELECTRIC POWER/INSTITUTIONAL FACTORS
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
HYDROELECTRIC POWER/INVENTORIES
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
HYDROELECTRIC POWER/LEGAL ASPECTS
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
HYDROELECTRIC POWER/REGIONAL ANALYSIS
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
HYDROELECTRIC POWER/RESOURCE ASSESSMENT
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
HYDROELECTRIC POWER/RESOURCE POTENTIAL
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
HYDROELECTRIC POWER PLANTS
See also LOW-HEAD HYDROELECTRIC POWER PLANTS
HYDROELECTRIC POWER PLANTS/RESOURCE POTENTIAL
Hydro Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33367
HYDROELECTRICITY
See HYDROELECTRIC POWER
HYDROFLUORIC ACID/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
HYDROGEN/ABSORPTION
Activation of FeTi for hydrogen absorption: an electron microscopic study, 5:33874
HYDROGEN/BIBLIOGRAPHIES
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
HYDROGEN/CHEMICAL REACTIONS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
Reaction and deactivation of HCl(v=1,2) by Cl, Br, and H atoms, 5:33932
HYDROGEN/DISTRIBUTION
Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report, 5:33351 (DOE/JPL—955492(Vol.2)(Pt.2))
HYDROGEN/INTERATOMIC FORCES
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
HYDROGEN/METALLURGICAL EFFECTS
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
Influences of gaseous environment on low growth-rate fatigue crack propagation in steels. Annual report No. 1, January 1980. Report No. FPL/R/80/1030, 5:33858 (DOE/ER/10389—1)
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
HYDROGEN/MOLECULAR STRUCTURE
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
HYDROGEN/SEPARATION PROCESSES
Process for hydrogen recovery from ammonia purge gases (Patent), 5:33364
HYDROGEN/SOLUBILITY
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
HYDROGEN/TRANSPORT
Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report, 5:33351 (DOE/JPL—955492(Vol.2)(Pt.2))
HYDROGEN 3
See TRITIUM
HYDROGEN CHLORIDES
See HYDROCHLORIC ACID
HYDROGEN FLUORIDES
See HYDROFLUORIC ACID
HYDROGEN FUEL CELLS/FEASIBILITY STUDIES
Hydrogen-air electrochemical energy installation for electric automobiles, 5:33838 (DOE-tr—227)
HYDROGEN IONS 1 PLUS/ION-ATOM COLLISIONS
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
Scaled proton ionization cross sections in the Born approximation, 5:34259
HYDROGEN IONS 2 PLUS/ION-ATOM COLLISIONS
Crossed beam studies of low energy proton transfer reactions: H_2^+(Ar,H) HAr^+ from 0.4 to 7.8 eV (c.m.), 5:34240
HYDROGEN NITRATES
See NITRIC ACID
HYDROGEN PRODUCTION/BENCH-SCALE EXPERIMENTS
Preliminary results from bench-scale testing of a sulfur-iodine thermochemical water-splitting cycle, 5:33354 (GA-A—15935)
HYDROGEN PRODUCTION/COMMERCIALIZATION
Solar/hydrogen systems for the 1985 to 2000 time frame. Volume I. Solar/hydrogen systems assessment. Final report, 5:33353 (DOE/JPL—955492(Vol.1))
HYDROGEN PRODUCTION/COST
Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202
HYDROGEN PRODUCTION/ELECTROLYSIS
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
Electrochemical route to coal gasification and its technological implications, 5:33195
Solar/hydrogen systems technologies. Volume II (Part 1 of 2). Solar/hydrogen systems assessment. Final report, 5:33350 (DOE/JPL—955492(Vol.2)(Pt.1))
Solar/hydrogen systems for the 1985 to 2000 time frame. Volume I. Solar/hydrogen systems assessment. Final report, 5:33353 (DOE/JPL—955492(Vol.1))
HYDROGEN PRODUCTION/EVALUATION
LASL thermochemical hydrogen program status on September 30, 1980, 5:33355 (LA-UR—80-2400)
HYDROGEN PRODUCTION/MATERIALS
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
HYDROGEN PRODUCTION/TECHNOLOGY ASSESSMENT
Solar/hydrogen systems technologies. Volume II (Part 1 of 2). Solar/hydrogen systems assessment. Final report, 5:33350 (DOE/JPL—955492(Vol.2)(Pt.1))
HYDROGEN PRODUCTION/THERMOCHEMICAL PROCESSES
LASL thermochemical hydrogen program status on September 30, 1980, 5:33355 (LA-UR—80-2400)
Preliminary results from bench-scale testing of a sulfur-iodine thermochemical water-splitting cycle, 5:33354 (GA-A—15935)
HYDROGEN SILICATES
See SILICIC ACID
HYDROGEN STORAGE
See also HYDRIDES
Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)

HYDROGEN STORAGE/MATERIALS
Chemical/hydrogen energy storage systems. Annual report, January 1, 1979-December 31, 1979, 5:33352 (BNL—51226)
HYDROGEN STORAGE/TECHNOLOGY ASSESSMENT
Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report, 5:33351 (DOE/JPL—955492(Vol.2)(Pt.2))
HYDROGEN SULFATES
See SULFURIC ACID
HYDROGEN SULFIDES/CHEMICAL REACTIONS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
HYDROGEN SULFIDES/METALLURGICAL EFFECTS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
HYDROGEN SULFIDES/REMOVAL
Acid gas removal by versatile Shell processes (Sulfinol; ADIP), 5:33283
High CO_2-high H_2S removal with SELEXOL solvent, 5:33282
HYDROGENATION/CATALYSTS
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
HYDROLYSIS/FEASIBILITY STUDIES
Feasibility study for anaerobic digestion of agricultural crop residues. Dynatech report No. 1935, 5:33431 (SERI/TR—8157-1-T1)
HYDROXAMIC ACIDS/SORPTIVE PROPERTIES
Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)
HYDROXAMIC ACIDS/SYNTHESIS
Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)

I

IAEA SAFEGUARDS
Potential for meeting IAEA safeguards goals for reprocessing, 5:33341 (AGNS—35900-Conf-85)
ICES/DEMONSTRATION PROGRAMS
University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—)
IDAHO
See also RAFT RIVER VALLEY
IDAHO/GEOLOGY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
IDAHO/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
IDAHO/HYDROLOGY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
IDEAL FLOW/NUMERICAL SOLUTION
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
IGT WASTE PROCESS
See BIOGAS PROCESS
ILLINOIS/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
ILLINOIS/MINERAL RESOURCES
Minerals in the economy of Illinois, 5:33686
ILLITE/PHYSICAL PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
ILLITE/THERMODYNAMIC PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
IMAGE INTENSIFIERS/USES
Advanced imaging techniques for submicrometer devices, 5:33992
IMAGE PROCESSING/TRANSFER FUNCTIONS
Coded aperture imaging: the modulation transfer function for uniformly redundant arrays, 5:34387
IMINES/CHEMICAL REACTIONS
Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens (Patent), 5:33213
IMMUNITY/DOSE-RESPONSE RELATIONSHIPS
Effect of microwaves on the immune system. Technical report, 5:34189 (AD-A—076768)
IMMUNITY/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
IN 519
See ALLOY-IN-519
INCINERATORS/DESIGN
Mound Facility explosives incinerator, 5:34102 (MLM—2762(OP))
INCINERATORS/PERFORMANCE
Mound Facility explosives incinerator, 5:34102 (MLM—2762(OP))
INCOLOY 800/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCOLOY 800/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCOLOY 800/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCOLOY 802/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCOLOY 802/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCOLOY 802/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 617/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 617/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 617/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 713LC/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 713LC/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INCONEL 713LC/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
INDIA/AGRICULTURE
Organic recycling in agriculture, 5:33814 (NP—25012)
INDIA/ENERGY SOURCE DEVELOPMENT
Energy substitution in rural domestic sector: use of cattle dung as a source of fuel, 5:33426 (NP—25011)
INDIA/FERTILIZERS
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)
INDIA/METEOROLOGY
Atmospheric boundary layer measurements during summer MONEX 79 at Digha, India, 5:34110 (BNL—51149)
INDIANA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
INDIUM/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
INDIUM ALLOYS/ANODIZATION
Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010

INDIUM ALLOYS/SPUTTERING
Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010
INDOOR AIR POLLUTION/MONITORING
Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
INDUSTRIAL MEDICINE/PLANNING
Epidemiological considerations (Solar cell industry), 5:34217 (BNL—51118)
INDUSTRIAL PLANTS
See also COAL GASIFICATION PLANTS
COAL LIQUEFACTION PLANTS
COAL PREPARATION PLANTS
FEED MATERIALS PLANTS
FOUNDRIES
METHANOL PLANTS
NATURAL GAS PROCESSING PLANTS
OIL SAND PROCESSING PLANTS
SNG PLANTS
WASTE PROCESSING PLANTS
INDUSTRIAL PLANTS/CO-GENERATION
Cogeneration of electricity in the St. Louis region: industrial potential, 5:33797 (CUERS-Report—10)
INDUSTRIAL PLANTS/GEOTHERMAL PROCESS HEAT
Direct application of east coast geothermal resources in a frozen food plant. Final report, 5:33578 (DOE/ET/27228—T1)
INDUSTRIAL PLANTS/HEATERS
Industrial application fluidized bed combustion. Category III: indirect fired heaters. Quarterly technical report No. 14, October 1-December 31, 1979, 5:34065 (FE—2471-45)
INDUSTRIAL PLANTS/OCCUPATIONAL SAFETY
Industrial hygiene surveys of semiconductor plants, 5:34216 (BNL—51118)
INDUSTRIAL PLANTS/POWER GENERATION
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
INDUSTRIAL PLANTS/SOLAR PROCESS HEAT
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))
INDUSTRIAL SECTOR
See INDUSTRY
INDUSTRIALIZED COUNTRIES
See DEVELOPED COUNTRIES
INDUSTRY
See also COAL INDUSTRY
METAL INDUSTRY
MINERAL INDUSTRY
NATURAL GAS INDUSTRY
NUCLEAR INDUSTRY
OIL SHALE INDUSTRY
PETROLEUM INDUSTRY
SOLAR INDUSTRY
SYNTHETIC FUELS INDUSTRY
WOOD PRODUCTS INDUSTRY
INDUSTRY/ENERGY CONSERVATION
Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries., 5:33786
INDUSTRY/GAS TURBINES
Advanced industrial gas turbine technology readiness demonstration. Quarterly technical progress report No. 12, 1 December 1979-29 February 1980, 5:33795 (DOE/OR/05035—T1)
INDUSTRY/HEAT RECOVERY EQUIPMENT
Useful heat from waste heat, 5:33799 (NP—24997)
INDUSTRY/HEATING OILS
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
INDUSTRY/OCCUPATIONS
Generation of the industry/occupation wage matrix and related matters. Final report, 5:33671 (DOE/CS/20258—2)
INDUSTRY/REFRIGERATING MACHINERY
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
INDUSTRY/SOLAR PROCESS HEAT
Analysis of the economic potential of solar thermal energy to provide industrial process heat in the United States, 5:33507
Potential for industrial use of solar energy in the United Kingdom, 5:33505
US Government appraisal of the potential of solar energy for industry, 5:33508
INDUSTRY/WAGES
Generation of the industry/occupation wage matrix and related matters. Final report, 5:33671 (DOE/CS/20258—2)
INERTIAL CONFINEMENT/REVIEWS
Inertial confinement fusion reactor systems, 5:34423 (LA-UR—80-2499)
INERTIAL CONFINEMENT/TECHNOLOGY ASSESSMENT
Inertial confinement fusion reactor systems, 5:34423 (LA-UR—80-2499)
INFORMATION SYSTEMS/COMPUTER GRAPHICS
Computer-aided visualization of database structural relationships, 5:34458 (LBL—10437)
INFORMATION SYSTEMS/DIRECTORIES
Feasibility study for establishing a centralized geothermal data base for New Mexico. Final report, June 1, 1979-October 15, 1979, 5:33547 (NMEI—50)
INFORMATION VALIDATION
Integrated approach to data editing, 5:34457 (CONF-800820—5)
INFRARED RADIATION/MEETINGS
Second international conference on infrared physics (ETH Zurich, March 5-9, 1979), 5:34031 (CONF-790355—)
INORGANIC COMPOUNDS/BIOLOGICAL EFFECTS
In vitro tests and morbidity in man: special characteristics of inorganic materials, 5:34213 (BNL—51118)
INPUT-OUTPUT ANALYSIS
See ENERGY ANALYSIS
IN-SITU RETORTING/EQUIPMENT
Energy from the in situ processing Antrim shale: process equipment used in the extraction trials, 5:33291 (FE—2346-74)
IN-SITU RETORTING/FEASIBILITY STUDIES
Dow true in situ process for recovery of energy from the Antrim shale, 5:33294
IN-SITU RETORTING/FIELD TESTS
Dow true in situ process for recovery of energy from the Antrim shale, 5:33294
INSOLATION/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
INSOLATION/CALCULATION METHODS
Solar index prediction methodology preliminary analysis, 5:33384 (DOE/ET/20090—4)
INSOLATION/GEOGRAPHICAL VARIATIONS
Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
INSOLATION/NUMERICAL DATA
Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
INSOLATION/SEASONAL VARIATIONS
Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
INSULATION (THERMAL)
See THERMAL INSULATION
INTEGRATED CIRCUITS/COMPUTERIZED SIMULATION
Delay modeling in logic simulation, 5:34058 (SAND—80-0420C)
INTEGRATED COMMUNITY ENERGY SYSTEMS
See ICES
INTEGRATED UTILITY SYSTEMS
See TOTAL ENERGY SYSTEMS
INTENSIFIERS (IMAGE)
See IMAGE INTENSIFIERS
INTERCONNECTED POWER SYSTEMS/ECONOMIC ANALYSIS
Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system, 5:33741 (P—500-80-019)
INTERCONNECTED POWER SYSTEMS/ENVIRONMENTAL IMPACTS
Revised draft environmental impact statement. The role of the Bonneville Power Administration in the Pacific Northwest power supply system, including its participation in a hydro-thermal power program, 5:33599 (DOE/EIS—0066)
INTERCONNECTED POWER SYSTEMS/FEASIBILITY STUDIES
Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system, 5:33741 (P—500-80-019)
INTERCONNECTED POWER SYSTEMS/PLANNING
Revised draft environmental impact statement. The role of the Bonneville Power Administration in the Pacific Northwest power supply system, including its participation in a hydro-thermal power program, 5:33599 (DOE/EIS—0066)
INTERMEDIATE TECHNOLOGY
See APPROPRIATE TECHNOLOGY
INTERNAL COMBUSTION ENGINES
See also DIESEL ENGINES
GAS TURBINE ENGINES
STRATIFIED CHARGE ENGINES

INTERNAL COMBUSTION ENGINES/EXHAUST GASES
Evaluation of methanol for reduced exhaust emissions in a single-cylinder research engine, 5:33843 (CONF-790520—)
INTERNAL CONTAMINATION
See RADIONUCLIDE KINETICS
INTERSTELLAR SPACE/COSMOCHEMISTRY
Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds, 5:34237
INTERSTELLAR SPACE/NEBULAE
Model for gas phase chemistry in interstellar clouds: I. The basic model, library of chemical reactions, and chemistry among C, N, and O compounds, 5:34237
INTERSTITIAL WATER/CHEMICAL COMPOSITION
Geochemistry of China's oilfield water discussed, 5:33271 (JPRS—75887)
INTERSTITIAL WATER/LEADING ABSTRACT
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
INVERTEBRATES
See also ARTHROPODS
MOLLUSCS
INVERTEBRATES/BIODEGRADATION
Arthropod use of invertebrate carrion, 5:34144 (DOE/EV/00641—34)
INVISCID FLOW
See IDEAL FLOW
IODINE 131/RADIONUCLIDE MIGRATION
Stochastic model of radioiodine transport, 5:34135 (CONF-8004111—1)
ION EXCHANGE CHROMATOGRAPHY
Chelating ion exchange with macroreticular hydroxamic acid resins, 5:33927 (IS-T—910)
ION PLASMA WAVES/CYCLOTRON FREQUENCY
Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma, 5:34409
ION SOURCES/BEAM TRANSPORT
Ion beam propagation in a filamented channel, 5:34424 (NRL-MR—4180)
ION SOURCES/PERFORMANCE
Operating experience and cesium recycling on the LASL polarized triton source, 5:34076 (LA-UR—80-1905)
ION WAVE INSTABILITY/PARAMETRIC INSTABILITIES
Parametric excitation of ion quasi-mode by the pump near the ion cyclotron frequency, 5:34410
ION-ATOM COLLISIONS/CHARGE EXCHANGE
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
ION-ATOM COLLISIONS/ENERGY TRANSFER
Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
ION-ATOM COLLISIONS/IONIZATION
Scaled proton ionization cross sections in the Born approximation, 5:34259
Secondary electron emission in ion-atom collisions, 5:34257 (PNL-SA—7417)
IONIZATION CALORIMETERS
See SHOWER COUNTERS
IONIZING RADIATIONS/GENETIC EFFECTS
Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Annual progress report, November 1, 1979 to October 31, 1980, 5:34181 (DOE/EV/00637—9)
IOWA/ENERGY DEMAND
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
IOWA/ENERGY SUPPLIES
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
IOWA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
IOWA/SURFACE MINING
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234
IRIDIUM/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
IRON/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
IRON/CATALYTIC EFFECTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
IRON/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
IRON/TOXICITY
Possible adverse effects of trace materials, 5:34206 (BNL—51118)
IRON ALLOYS
See also IRON BASE ALLOYS
IRON ALLOYS/MAGNETIC PROPERTIES
Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
IRON ALLOYS/MICROSTRUCTURE
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
IRON ALLOYS/PHYSICAL RADIATION EFFECTS
Gamma prime hardened nickel-iron based superalloy (Patent), 5:33889
IRON BASE ALLOYS
See also ALLOY-HK-40
STEELS
IRON BASE ALLOYS/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
IRON BASE ALLOYS/MECHANICAL PROPERTIES
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
IRON BASE ALLOYS/MICROSTRUCTURE
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
IRON BASE ALLOYS/SORPTIVE PROPERTIES
Activation of FeTi for hydrogen absorption: an electron microscopic study, 5:33874
IRON OXIDES/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
IRON OXIDES/RECOVERY
Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
IRON SULFATES/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
IRON SULFATES/EQUILIBRIUM
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
IRON-AIR BATTERIES/DESIGN
Air battery and electrochemical method (Patent), 5:33645
Iron/air battery system having circulating electrolyte and a horizontal cell configuration (Patent; 58 Wh/lb), 5:33648
IRON-NICKEL BATTERIES/CATHODES
Fabrication of alkaline batteries (Patent), 5:33654
IRRADIATION PLANTS/PERFORMANCE
Irradiation of sewage sludge using cesium-137: a comparative assessment, 5:33348 (SAND—80-7097)
IRRIGATION/SOLAR WATER PUMPS
Contribution of solar energy to the development of arid zones: experience of solar assisted mechanical and electrical systems for industrial and agricultural processes, 5:33454
ISABELLE STORAGE RINGS/BEAM-BEAM INTERACTIONS
Empirical model for controlling beam-beam effects in ISABELLE, 5:34070 (BNL—28033)
ISABELLE STORAGE RINGS/SUPERCONDUCTING MAGNETS
ISABELLE vacuum systems, 5:34079 (BNL—27767)
ISABELLE STORAGE RINGS/VACUUM SYSTEMS
ISABELLE vacuum systems, 5:34079 (BNL—27767)
ISOMERIZATION
See CHEMICAL REACTIONS
ISOTOPE PRODUCTION
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
ISX TOKAMAK/REACTOR FUELING
Results of hydrogen pellet injection into ISX-B, 5:34417 (ORNL/TM—7422)
IUS
See TOTAL ENERGY SYSTEMS

IVORY COAST/ENERGY CONSUMPTION
Energy consumption: case of the Ivory Coast, Senegal and Ghana (Electricity and gasoline), 5:33743

J

J-3105 RESONANCES
See PSI-3105 RESONANCES
JAPAN/LMFBR TYPE REACTORS
Fast breeder reactor development in Japan. Progress report, January-March 1979, 5:33614 (JAPFNR—509)
Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
JET MODEL/PROTON-PROTON INTERACTIONS
High p/sub T/ transverse momentum physics at the CERN ISR, 5:34283 (LBL—8957)
JET MODEL/TRANSVERSE MOMENTUM
Are high-p/sub T/ events dominated by non-jet processes, 5:34271 (COO—3071-248)
JOSEPHSON JUNCTIONS/ELECTRIC CURRENTS
Excess current in Nb and Nb_3Ga Josephson junctions, 5:34003
JOSEPHSON JUNCTIONS/ELECTRIC POTENTIAL
Higher standard voltage generated by multiple Josephson junctions, 5:33981
JOSEPHSON JUNCTIONS/FABRICATION
Alternatives in fabricating submicron niobium Josephson junctions, 5:33995
Digital Josephson technology: present and future, 5:34013
Fabrication of submicron Josephson microbridges using optical projection lithography and liftoff techniques, 5:33996
Fast superconducting instruments, 5:34020
Josephson tunneling through Ge-Sn barriers, 5:34005
Millimeter wave response of Nb variable thickness bridges, 5:34001
Progress on millimeter wave Josephson junction mixers, 5:34019
Properties of variable thickness bridges on GaAs substrates, 5:34002
Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010
Super-Schottky and Josephson-effect devices using niobium on thin silicon membranes, 5:34006
Surfaces of high-T/sub c/ Nb_3Ge films as studied by electron tunneling and auger electron spectroscopy, 5:34009
JOSEPHSON JUNCTIONS/FREQUENCY CONTROL
Biasing for precise frequency in a frequency-agile Josephson junction, 5:33983
JOSEPHSON JUNCTIONS/NOISE
Phase instability noise in Josephson junctions, 5:33989
JOSEPHSON JUNCTIONS/OPERATION
Differential heterodyne frequency conversion at 0.4 mm wavelength, 5:33990
Microwave parametric amplifiers using externally pumped Josephson junctions, 5:33988
Mixing with Josephson junctions in the far infrared, 5:33987
JOSEPHSON JUNCTIONS/PERFORMANCE
Differential heterodyne frequency conversion at 0.4 mm wavelength, 5:33990
Digital Josephson technology: present and future, 5:34013
Excess current in Nb and Nb_3Ga Josephson junctions, 5:34003
Fabrication of microbridge Josephson junctions using electron beam lithography, 5:33994
Fast superconducting instruments, 5:34020
High-frequency properties of microbridge and point contact Josephson junctions, 5:33999
High-performance Josephson interferometer latching logic and power supplies, 5:34017
Improved materials for superconducting electronics, 5:34007
Josephson mixers at submillimetre wavelengths: present experimental status and future developments, 5:33986
Josephson tunneling through Ge-Sn barriers, 5:34005
Junctions - types, properties, and limitations, 5:33991
Light-sensitive Josephson junctions: ten years ago, ten years from now, 5:34000
Microwave parametric amplifiers using externally pumped Josephson junctions, 5:33988
Millimeter wave response of Nb variable thickness bridges, 5:34001
Mixing with Josephson junctions in the far infrared, 5:33987
Properties of variable thickness bridges on GaAs substrates, 5:34002
Study of the properties of coherent microbridges coupled by external shunts, 5:33998
Super-Schottky and Josephson-effect devices using niobium on thin silicon membranes, 5:34006
Superconducting microbridges and arrays, 5:33997
JOSEPHSON JUNCTIONS/PERFORMANCE TESTING
Progress on millimeter wave Josephson junction mixers, 5:34019
JOSEPHSON JUNCTIONS/RESEARCH PROGRAMS
Superconductor-semiconductor device research, 5:34004
JOSEPHSON JUNCTIONS/SENSITIVITY
Light-sensitive Josephson junctions: ten years ago, ten years from now, 5:34000
JOSEPHSON JUNCTIONS/SIMULATION
Electrical analog of a Josephson junction, 5:34577 (DOE/ER/01569—146)
JOSEPHSON JUNCTIONS/STABILITY
Phase instability noise in Josephson junctions, 5:33989
JOSEPHSON JUNCTIONS/USES
Biasing for precise frequency in a frequency-agile Josephson junction, 5:33983
Current-switched full adder fabricated by photolithographic techniques, 5:34015
Higher standard voltage generated by multiple Josephson junctions, 5:33981
Memory device utilizing the storage of Abrikosov vortices at an array of pinning sites in a superconducting film, 5:34016
Prototype for a commercial Josephson-effect voltage standard, 5:33980

K

K01
See KAONS NEUTRAL SHORT-LIVED
KANSAS/BIOMASS PLANTATIONS
Fuels from woody biomass. First annual report, 3 April 1978-2 January 1979, 5:33422 (DOE/ET/20049—T1)
KANSAS/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
KAON BEAMS/BEAM PRODUCTION
Monochromatic neutral kaon beam, 5:34067 (LA—8444-MS)
KAON MINUS REACTIONS/MULTIPLE PRODUCTION
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
KAON MINUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
KAON PLUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
KAON REACTIONS/COHERENT PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
KAON REACTIONS/MULTIPLE PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
KAONS/STRUCTURE FUNCTIONS
Determination of the pion and kaon structure functions, 5:34296
KAONS NEUTRAL SHORT-LIVED/WEAK HADRONIC DECAY
Penguins and the $\Delta I = 1/2$ rule, 5:34290 (FERMILAB-CONF—80/66-THY)
KELP
See SEAWEEDS
KENTUCKY/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
KEROGEN/NUCLEAR MAGNETIC RESONANCE
Current methods of oil shale analysis and new developments (NMR), 5:33297
KEVLAR
See ARAMIDS
KIESELGUHR
See DIATOMACEOUS EARTH
KRYPTON/AUTOIONIZATION
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243

KRYPTON/ENERGY-LEVEL TRANSITIONS
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
KRYPTON IONS/ENERGY-LEVEL TRANSITIONS
Radiative decay of the 2p ^{2}P/sub 3/2,1/2/ states of lithiumlike krypton (Z=36) and the 2s 2p $^3P_1$ state of berylliumlike krypton, 5:34244

L

LABOR
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
LABOR/FORECASTING
Labor Market Projections Model: a user's guide to the population, labor force, and unemployment projections model at Lawrence Berkeley Laboratory, 5:33673 (LBL—11349)
LAMINAR FLOW/CONVECTION
Combined radiation convection in thermally developing Poiseuille flow with scattering, 5:34037
LAMINAR FLOW/RADIANT HEAT TRANSFER
Combined radiation convection in thermally developing Poiseuille flow with scattering, 5:34037
LAMPF LINAC/OPERATION
Medium-energy physics program. Progress report, February 1-April 30, 1979, 5:34066 (LA—8257-PR)
LAMPF LINAC/RESEARCH PROGRAMS
Medium-energy physics program. Progress report, February 1-April 30, 1979, 5:34066 (LA—8257-PR)
LAMPF LINAC/STORAGE RINGS
Injection system for the Proton Storage Ring at LASL. Final report, 5:34078 (LA-UR—80-1945)
LASL high-current proton storage rings, 5:34086 (LA-UR—80-1946)
LAND POLLUTION/ENVIRONMENTAL IMPACTS
Terrestrial perturbation experiments as an environmental assessment tool, 5:33679 (ORNL/TM—7186)
LAND USE/ENVIRONMENTAL IMPACTS
Carbon Dioxide Effects Research and Assessment Program. The role of tropical forests on the world carbon cycle, 5:34148 (CONF-800350—)
LANGUAGES (PROGRAMMING)
See PROGRAMMING LANGUAGES
LANTHANIDES
See RARE EARTHS
LANTHANUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
LANTHANUM ALLOYS/DEHYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
LANTHANUM ALLOYS/HYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
LANTHANUM CHROMITES
See CHROMIUM OXIDES
LANTHANUM HYDRIDES/OPTICAL PROPERTIES
Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)
LASER FUSION REACTORS/REVIEWS
High-power pulsed lasers, 5:34427 (UCRL—52868)
Progress of laser fusion at Lawrence Livermore Laboratory, 5:34425
LASER IMPLOSIONS/COMPUTERIZED SIMULATION
One-dimensional computer simulations of exploding pusher targets for the Los Alamos Helios laser system, 5:34421 (LA—8458-MS)
LASER IMPLOSIONS/MATHEMATICAL MODELS
Model for laser driven ablative implosions, 5:34431
LASER IMPLOSIONS/SCALING LAWS
Model for laser driven ablative implosions, 5:34431
LASER MATERIALS/BIREFRINGENCE
Piezooptic coefficients of four neodymium-doped laser glasses, 5:33918
LASER MATERIALS/PHOTOELASTICITY
Piezooptic coefficients of four neodymium-doped laser glasses, 5:33918
LASER RADIATION/ELECTROMAGNETIC FIELDS
Laser driven grating linac, 5:34071 (BNL—28131)
LASER SPECTROSCOPY/PULSE TECHNIQUES
Brochure of the Picosecond Laser and Spectroscopy Laboratory, 5:34262
LASER SPECTROSCOPY/RESEARCH PROGRAMS
Brochure of the Picosecond Laser and Spectroscopy Laboratory, 5:34262
LASER TARGETS/ABLATION
Model for laser driven ablative implosions, 5:34431
LASER TARGETS/FABRICATION
Process for manufacture of inertial confinement fusion targets and resulting product (Patent), 5:33345
LASER TARGETS/STABILITY
Fusion microsphere targets, 5:33344 (UCRL—83399)
LASERS
See also GAS LASERS
NEODYMIUM LASERS
SEMICONDUCTOR LASERS
LASERS/AMPLIFIERS
Phoenix I energy extraction experiment, 5:34032 (SAND—80-0261)
LASERS/DESIGN
Laboratory evaluation of an N_2 laser fluorosensor, 5:34098 (EGG—1183-2369)
Study of lasers. Final report, 15 July 1976-14 July 1979, 5:34028 (AD-A—076507)
LASL
(Los Alamos Scientific Laboratory.)
LASL/ALARM SYSTEMS
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
LASL/SECURITY
Los Alamos Scientific Laboratory long-range alarm system, 5:34021 (LA-UR—80-1617)
LATENT HEAT STORAGE/MATERIALS
Phase change/heat storage materials data compilation. Final technical report, August 1978-January 1979, 5:33640 (AD-A—076414)
LATENT HEAT STORAGE/PHASE CHANGE MATERIALS
Development of intermediate temperature thermal storage systems. Final technical report, April 1, 1978-May 31, 1979, 5:33641 (DOE/CS/35760—T1)
LAWRENCE BERKELEY LABORATORY/AFFIRMATIVE ACTION
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
LAWRENCE BERKELEY LABORATORY/RADIATION MONITORING
Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
LAWRENCE BERKELEY LABORATORY/RADIOACTIVE WASTE MANAGEMENT
Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
LAWRENCE LIVERMORE LABORATORY/DAMAGE
LLNL earthquake impact analysis committee report on the Livermore, California, earthquakes of January 24 and 26, 1980, 5:34221 (UCRL—52956)
LEAD/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
LEAD/MULTI-ELEMENT ANALYSIS
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
LEAD 207/ENERGY LEVELS
Suppression of the transverse scattering amplitude in ^{207}Pb, 5:34341
LEAD 207/PION MINUS REACTIONS
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
LEAD 207 TARGET/ELECTRON REACTIONS
Suppression of the transverse scattering amplitude in ^{207}Pb, 5:34341
LEAD 208 REACTIONS/ELASTIC SCATTERING
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 REACTIONS/TOTAL CROSS SECTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 TARGET/ALPHA REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 TARGET/CALCIUM 40 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 TARGET/DEUTERON REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 TARGET/HELIUM 3 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
LEAD 208 TARGET/LEAD 208 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317

LEAD 210/RADIOECOLOGICAL CONCENTRATION
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
LEAD ALLOYS
See also LEAD BASE ALLOYS
LEAD ALLOYS/ANODIZATION
Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010
LEAD ALLOYS/SPUTTERING
Rf sputter anodisation of lead-indium films studied by ellipsometry, 5:34010
LEAD BASE ALLOYS/MECHANICAL PROPERTIES
Lead-acid storage battery having Pb-Cd-Zn-Sn plate straps (Patent), 5:33660
LEAD COMPOUNDS/DOMAIN STRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
LEAD COMPOUNDS/MICROSTRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
LEAD COMPOUNDS/PHOTOLYSIS
Optical extinction and N2 gas evolution on photodecomposition of Pb(N3)2. Final report, 1972-1975, 5:33935 (AD-A—077110)
LEAD ISOTOPES/ENVIRONMENTAL TRANSPORT
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
LEAD ISOTOPES/ISOTOPE RATIO
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
LEAD OXIDES/PROXIMITY EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
LEAD-ACID BATTERIES/CHARGE STATE
Method and apparatus for determining the capacity of lead acid storage batteries (Patent), 5:33652
LEAD-ACID BATTERIES/COMMERCIALIZATION
Commercialization strategy for lead/acid batteries in utility load leveling applications, 5:33594 (DOE/ET/26934—1)
LEAD-ACID BATTERIES/CONNECTORS
Battery strap and post cast-on multi use mold (Patent), 5:33653
Lead-acid storage battery having Pb-Cd-Zn-Sn plate straps (Patent), 5:33660
LEAD-ACID BATTERIES/COVERINGS
Explosion resistant battery cover design (Patent), 5:33661
LEAD-ACID BATTERIES/MANUFACTURING
Apparatus and method for stacking battery plates and separators (Patent), 5:33646
Battery cell soldering apparatus (Patent), 5:33647
Electric storage batteries (Patent; flat grid plate fabrication), 5:33655
LEAD-ACID BATTERIES/OPTIMIZATION
Method for engineering calculation and selection of parameters for the power systems of battery-powered electric automobiles, 5:33832 (DOE-tr—239)
LEAD-ACID BATTERIES/PLATES
Electric storage batteries (Patent; flat grid plate fabrication), 5:33655
LEAVES/DECOMPOSITION
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
LEAVES/MULTI-ELEMENT ANALYSIS
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
LEGUMINOSAE/NITROGEN FIXATION
Nitrogen cycling: water use efficiency interactions in semi-arid ecosystems in relation to management of tree legumes (Prosopis), 5:34180 (CONF-8004108—1)
LEGUMINOSAE/PLANT BREEDING
Methods for acquisition, storage, and evaluation of leguminous tree germplasm, 5:34143 (CONF-8006101—1)
LEGUMINOSAE/USES
Uses of tree legumes in semi-arid regions, 5:33420 (CONF-8006100—1)
LIFE STYLES/ENERGY CONSUMPTION
Energy use and human life styles, 5:33677
LIFE-CYCLE COST
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
LIGASES/CHEMICAL PROPERTIES
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
LIGASES/PURIFICATION
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
LIGHT BULBS/ENERGY CONSUMPTION
Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
LIGHT BULBS/PERFORMANCE
Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
LIGHT NUCLEI/E1-TRANSITIONS
Selection rule for E1 transitions, 5:34352
LIGHTING SYSTEMS/ELECTRIC BRIDGES
Bridge cutout (Austrian Patent), 5:33958 (SAND—80-6016)
Bridge cutout, in particular for incandescent lamps to be connected in series (Austrian Patent), 5:33959 (SAND—80-6017)
LIGHTING SYSTEMS/ENERGY CONSUMPTION
Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
LIGHTING SYSTEMS/PERFORMANCE
Cost effectiveness of long life incandescent lamps and energy buttons, 5:33767 (LBL—10789)
LIGNITE/FLUIDIZED-BED COMBUSTION
Atmospheric Fluidized Bed Combustion testing of North Dakota lignite, 5:33237 (CONF-800428—7)
LIGNITE/PRODUCTION
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
LIGNITE/PYROLYSIS
Rates of light gas production by devolatilization of coals and lignite, 5:33211
LINACS
See LINEAR ACCELERATORS
LINEAR ACCELERATORS
See also FMIT LINAC
LAMPF LINAC
LINEAR ACCELERATORS/BEAM DYNAMICS
Matching bunched beams to alternating gradient focusing systems, 5:34073 (LA—8442-MS)
LINEAR ACCELERATORS/CAVITY RESONATORS
Preliminary simulation studies of accelerator cavity loading, 5:34072 (LA—8405-MS)
LINEAR ACCELERATORS/COLLIDING BEAMS
SLAC linear collider, 5:34085 (SLAC-PUB—2526)
LINEAR ACCELERATORS/ELECTROMAGNETIC FIELDS
Laser driven grating linac, 5:34071 (BNL—28131)
LINEAR ACCELERATORS/MATHEMATICAL MODELS
Preliminary simulation studies of accelerator cavity loading, 5:34072 (LA—8405-MS)
LINEAR ACCELERATORS/QUADRUPOLES
Radio-frequency quadrupole: general properties and specific applications, 5:34074 (LA-UR—80-1855)
LIQUEFIED PETROLEUM GASES/COMBUSTION
Control and extinguishment of LPG fires. Final report, 5:33270 (DOE/EV/06020—T3)
LIQUID ASPHALT
See RESIDUAL FUELS
LIQUID CRYSTALS/ORDER PARAMETERS
Surface-induced ordering of a liquid crystal in the isotropic phase. II. 4-methoxybenzylidene-4'-n-butylaniline (MBBA), 5:33917
LIQUID CRYSTALS/STRUCTURE FACTORS
Surface-induced ordering of a liquid crystal in the isotropic phase. II. 4-methoxybenzylidene-4'-n-butylaniline (MBBA), 5:33917
LIQUID DROP MODEL
Shape parametrization for liquid-drop studies, 5:34362
LIQUID METAL FAST BREEDER REACTORS
See LMFBR TYPE REACTORS
LIQUID METAL TEST FACILITIES
See TEST FACILITIES
LIQUIDS
See also LIQUID CRYSTALS
LIQUIDS/EVAPORATION
Vapor/liquid interaction and entrainment in falling film evaporators, 5:34266
LIQUIDS/FLUCTUATIONS
Fluctuation expressions for nonequilibrium distribution functions in adiabatic flows, 5:34267
LITHIUM/CRYSTAL STRUCTURE
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
LITHIUM/DEUTERON REACTIONS
Neutron environment in d + Li facilities, 5:34082 (HEDL-SA—2123-FP)
LITHIUM/F CENTERS
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
LITHIUM/PHYSICAL PROPERTIES
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
LITHIUM 6 REACTIONS/CHARGE-EXCHANGE REACTIONS
Gamow-Teller sum rules and the $^{14}C(^{6}Li,^{6}He)^{14}N$reaction, 5:34323

LITHIUM 7 REACTIONS/COMPOUND-NUCLEUS REACTIONS
High-spin states and band structure in ^{76}Se, 5:34327
LITHIUM COMPOUNDS/FABRICATION
Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980 ($LiAlO_2$), 5:33754 (SAN—11276-4)
LITHIUM ISOTOPES/ISOTOPIC EXCHANGE
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
LITHIUM SILICATES/CRACKS
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
LITHIUM SILICATES/CRYSTAL STRUCTURE
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
LITHIUM SULFATES/VIBRATIONAL STATES
Raman spectroscopy of molten mixtures of lithium and potassium sulfate, 5:33929 (CONF-800808—6)
LITHIUM-SULFUR BATTERIES/COST
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
LITHIUM-SULFUR BATTERIES/DESIGN
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
LITHIUM-SULFUR BATTERIES/PERFORMANCE
Conceptual designs for utility load-leveling battery with Li/FeS cells, 5:33593 (ANL—80-20)
LMFBR TYPE REACTORS/BELLOWS
Research and development of bellows for LMFBR in Japan, 5:33622 (JAPFNR—502)
LMFBR TYPE REACTORS/CONTROL ROD WORTHS
Hybrid inverse kinetics method combining the Yang-Albrecht and three point techniques, 5:33620 (HEDL-TME—79-78)
LMFBR TYPE REACTORS/FUEL ASSEMBLIES
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II, 5:33617 (ENICO—1046)
Specialists' meeting on thermodynamics of FBR fuel subassemblies under nominal and non-nominal operating conditions. Summary report, 5:33621 (IWGFR—29)
UZU: three dimensional analytical code for local flow blockage in a nuclear fuel subassembly, 5:33623 (JAPFNR—503)
LMFBR TYPE REACTORS/FUEL PINS
Breeder reactor fuel fabrication development overview, 5:33619 (HEDL-SA—2112-FD)
LMFBR TYPE REACTORS/FUEL RODS
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1979-November 30, 1979, 5:33616 (DOE/ET/37240—72)
LMFBR TYPE REACTORS/MELTDOWN
General formulation of the isotherm migration method for reactor accident analysis, 5:33631 (CLM-P—582)
LMFBR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Development of bellows for sodium valve in Japan, 5:33625 (JAPFNR—507)
Investigation on the reliability of expansion joint for piping with probabilistic method, 5:33624 (JAPFNR—506)
LMFBR TYPE REACTORS/REACTOR KINETICS
Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II, 5:33617 (ENICO—1046)
LMFBR TYPE REACTORS/REACTOR MATERIALS
Gamma prime hardened nickel-iron based superalloy (Patent), 5:33889
Review of the CEA research and development activities in the field of structural materials for fast breeder reactors, 5:33615 (DOE/CEA/BMFT—13)
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
LMFBR TYPE REACTORS/RESEARCH PROGRAMS
Fast breeder reactor development in Japan. Progress report, January-March 1979, 5:33614 (JAPFNR—509)
LMFBR TYPE REACTORS/ROD DROP METHOD
Hybrid inverse kinetics method combining the Yang-Albrecht and three point techniques, 5:33620 (HEDL-TME—79-78)
LOAD MANAGEMENT/AUTOMATION
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume I. Summary final report, 5:33606 (JPL-PUBL—80-48(Vol.1))
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume II. Supporting data and analyses, 5:33607 (JPL-PUBL—80-48(Vol.2))
LOAD MANAGEMENT/CONTROL SYSTEMS
Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses, 5:33740 (JPL-PUB—80-48(Vol.2))
LOAD MANAGEMENT/COST BENEFIT ANALYSIS
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 5:33727
Handbook of five methodologies for the assessment of load management, 5:33709 (ANL/EES-TM—92)
LOAD MANAGEMENT/ENERGY STORAGE
New applications of energy storage in electric-heating and -cooling systems, 5:33759 (CONF-800210—4)
LOAD MANAGEMENT/EVALUATION
Handbook of five methodologies for the assessment of load management, 5:33709 (ANL/EES-TM—92)
LOAD MANAGEMENT/MEETINGS
Proceedings of the load-management customer-participation workshop, 5:33729
LOAD MANAGEMENT/STANDARDS
Proceedings of the load-management customer-participation workshop, 5:33729
LOCAL GROUP
See GALAXIES
LOFT REACTOR/CONSOLES
Meeting the reactor operator's information needs using functional analysis, 5:33629 (CONF-801107—6)
LOFT REACTOR/CONTROL ROOMS
Meeting the reactor operator's information needs using functional analysis, 5:33629 (CONF-801107—6)
LOS ALAMOS MESON PHYSICS FACILITY
See LAMPF LINAC
LOSS OF FLUID TEST REACTOR
See LOFT REACTOR
LOUISIANA/ENERGY FACILITIES
Siting energy related facilities in Louisiana's coastal zone, 5:34155
LOUISIANA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
LOW DOSE IRRADIATION/DOSE-RESPONSE RELATIONSHIPS
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
LOW INCOME GROUPS/EDUCATION
Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)
LOW-HEAD HYDROELECTRIC POWER PLANTS/FEASIBILITY STUDIES
Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power. Executive summary, 5:33598 (DOE/RA/23220—01)
LOW-HEAD HYDROELECTRIC POWER PLANTS/INSTITUTIONAL FACTORS
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
LOW-HEAD HYDROELECTRIC POWER PLANTS/LEGAL ASPECTS
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
LOW-HEAD HYDROELECTRIC POWER PLANTS/RESOURCE POTENTIAL
Hydro Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33367
LOW-LEVEL RADIOACTIVE WASTES/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
LP-GAS
See LIQUEFIED PETROLEUM GASES
LUMBER INDUSTRY
See WOOD PRODUCTS INDUSTRY
LUNGS/RADIATION DOSES
ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides, 5:34193 (DOE/EV/10343—6)
LUTETIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))

M

MA 754
See NICKEL BASE ALLOYS

MA 956
See IRON BASE ALLOYS
MACHINE PARTS/FABRICATION
Analysis of measurements based on singular value decomposition, 5:33953 (SAND—80-1482)
Deburring: technical capabilities and cost-effective approaches, Lessons 3 and 4, 5:33945 (BDX—613-2373)
Deburring: technical capabilities and cost-effective approaches, Lessons 9 and 10, 5:33947 (BDX—613-2421)
MACHINE PARTS/MACHINING
Deburring: technical capabilities and cost-effective approaches, Lessons 3 and 4, 5:33945 (BDX—613-2373)
Deburring: technical capabilities and cost-effective approaches, Lessons 9 and 10, 5:33947 (BDX—613-2421)
MACHINE PARTS/QUALITY CONTROL
Analysis of measurements based on singular value decomposition, 5:33953 (SAND—80-1482)
MACHINE PARTS/ULTRASONIC TESTING
Generalized ultrasonic system for microcomputer controlled data collection, 5:34047 (LA-UR—80-2040)
MACHINING/FEASIBILITY STUDIES
Preliminary study of high-speed machining, 5:33946 (BDX—613-2401)
MAGNESIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
MAGNESIUM/CATALYTIC EFFECTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
MAGNESIUM 24 TARGET/PION PLUS REACTIONS
Isospin quintets in the 1p and s-d shells, 5:34318
MAGNESIUM 26 TARGET/TRITON REACTIONS
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)
MAGNESIUM ALLOYS/DENSITY
Density measurements at high temperatures. Part XII. Specific volume and expansion of magnesium-zinc alloys in the solid and liquid states, 5:33883 (RFP-Trans—285)
MAGNESIUM COMPOUNDS/PHOTOELECTRIC EFFECT
Photoelectric effects in magnesium aluminum spinel, 5:33910
MAGNESIUM COMPOUNDS/PRECIPITATION
Magnesium aluminate spinel precipitation in MgO, 5:33903
MAGNESIUM OXIDES
See also SPINELS
MAGNESIUM OXIDES/CATALYTIC EFFECTS
Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix (Patent), 5:33260
MAGNESIUM OXIDES/GRAIN BOUNDARIES
Magnesium aluminate spinel precipitation in MgO, 5:33903
MAGNETIC FIELDS/MEASURING METHODS
Measurements of magnetic gradients from ocean waves, 5:33968
MAGNETIC MATERIALS/IMPLOSIONS
Explosive generation of high magnetic fields in large volumes and solid state applications, 5:34370 (LA-UR—80-2182)
MAGNETIC MATERIALS/SPIN GLASS STATE
Muon spin rotation and other microscopic probes of spin-glass dynamics, 5:34371 (LA-UR—80-2372)
MAGNETIC MIRROR TYPE REACTORS/HIGH-FREQUENCY HEATING
Report of the workshop on rf heating in mirror systems, 5:34394 (DOE/ER—0070)
MAGNETOHYDRODYNAMIC CHANNELS
See MHD CHANNELS
MAGNETOHYDRODYNAMIC GENERATORS
See MHD GENERATORS
MAGNETOHYDRODYNAMICS/FLOW MODELS
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
MAGNETOHYDRODYNAMICS/IDEAL FLOW
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
MAGNETOMETERS/OPTIMIZATION
Optimization of SQUID differential magnetometers, 5:33974
MAGNETOMETERS/SQUID DEVICES
Application of a microwave biased rf-SQUID-system to investigate magnetic after-effects, 5:33975
Measurements of magnetic gradients from ocean waves, 5:33968
Optimization of SQUID differential magnetometers, 5:33974
Signal detection in 1/f noise of SQUID magnetometers, 5:33977
SQUIDs and magnetotellurics with a remote reference, 5:33967
SQUIDs for measuring the magnetic properties of materials, 5:33965
MAGNETOTELLURIC SURVEYS/REMOTE SENSING
SQUIDs and magnetotellurics with a remote reference, 5:33967
MAINE/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
MAIZE/GENETIC VARIABILITY
Organization of the R chromosome region in maize, 5:34170 (COO—1300-45)
MAIZE OIL
See CORN OIL
MANAURITE 36X/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
MANAURITE 36X/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
MANAURITE 36X/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
MANGANESE/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
MANGANESE/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
MANGANESE FLUORIDES/MAGNETIC COMPRESSION
Explosive generation of high magnetic fields in large volumes and solid state applications, 5:34370 (LA-UR—80-2182)
MANITOBA/WOOD PRODUCTS INDUSTRY
Reductions in energy usage at Manitoba Forestry Resources: energy conservation, fuel oil substitution and electrical cost control, 5:33793 (CONF-7905177—1)
MANPOWER
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
MANPOWER/EDUCATION
Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)
MANURES/ANAEROBIC DIGESTION
Energy substitution in rural domestic sector: use of cattle dung as a source of fuel, 5:33426 (NP—25011)
Janata biogas plant, 5:33425 (NP—25010)
MANURES/ENERGY SOURCE DEVELOPMENT
Energy from biological processes, 5:33429 (OTA-E—124)
MARGINAL-COST PRICING/EVALUATION
Electric Utility Rate Design Study: comments on RDS Report No. 66, An Evaluation of Four Marginal Costing Methodologies, 5:33728
MARICULTURE
See AQUACULTURE
MARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
MARITIME TRANSPORT/FUEL SUBSTITUTION
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
MARITIME TRANSPORT/FUELS
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
MARSHES/LAND USE
Wetland energy crops, 5:33433
MARYLAND/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
MASS TRANSFER/MATHEMATICAL MODELS
Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste, 5:33334 (SAND—80-0312C)
MASSACHUSETTS/AIR QUALITY
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
MASSACHUSETTS/DISTRICT HEATING
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
MASSACHUSETTS/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
MASSACHUSETTS INSTITUTE TECHN. ALCATOR
See ALCATOR DEVICE

MATRICES/COMPARATIVE EVALUATIONS
Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes, 5:33316 (DOE/TIC—11219)
MATRIX MATERIALS/MECHANICAL PROPERTIES
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
MAXWELL EQUATIONS/ANALYTICAL SOLUTION
Electromagnetic fields in an axial symmetric waveguide with variable cross section, 5:34390 (SLAC-PUB—2547)
MAXWELL-BOLTZMANN EQUATION
See BOLTZMANN EQUATION
MECHANICAL DRAFT COOLING TOWERS/PLUMES
Drift deposition from mechanical draft cooling towers, 5:33589 (PNL-SA—7422)
MECHANICAL VIBRATIONS/COMPUTERIZED SIMULATION
Swept narrow band random on random, 5:33954 (SAND—80-1534)
MECHANICAL VIBRATIONS/MATHEMATICAL MODELS
Improved recursive formula for calculating shock response spectra, 5:33951 (SAND—80-1315C)
MEDICINES
See DRUGS
MELTDOWN/AFTER-HEAT
General formulation of the isotherm migration method for reactor accident analysis (LMFBR), 5:33631 (CLM-P—582)
MELTDOWN/THERMODYNAMICS
General formulation of the isotherm migration method for reactor accident analysis (LMFBR), 5:33631 (CLM-P—582)
MEMBRANES/DIFFUSION
Carrier facilitated transport through membranes, 5:33926 (ANL—80-71)
MEMORY DEVICES/DESIGN
Superconductive electronics in future computer designs, 5:34018
MESONS
See also POMERANCHUK PARTICLES
MESONS/PARTICLE PRODUCTION
Particle ratios, quarks, and Chao-Yang statistics, 5:34287
METAGALAXY
See UNIVERSE
METAL INDUSTRY
See also MINERAL INDUSTRY
METAL INDUSTRY/MACHINING
Preliminary study of high-speed machining, 5:33946 (BDX—613-2401)
METAL-GAS BATTERIES
See also CADMIUM-AIR BATTERIES
IRON-AIR BATTERIES
NICKEL-HYDROGEN BATTERIES
ZINC-CHLORINE BATTERIES
METAL-GAS BATTERIES/DESIGN
Air battery and electrochemical method (Patent), 5:33645
Method of precharging rechargeable metal oxide-hydrogen cells (Patent), 5:33644
METALS
See also ACTINIDES
RARE EARTHS
TRANSITION ELEMENTS
METALS/ENVIRONMENTAL TRANSPORT
Abstracts from a workshop on processes determining the input, behavior and fate of radionuclides and trace elements in continental shelf environments, 5:34164 (CONF-790382—(Absts.))
METALS/MINING
Directory of Washington mining operations, 1979, 5:33682
METALS/MUON PROBES
Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
Muon spin depolarization in nonmagnetic metals doped with paramagnetic impurities, 5:34253 (LA-UR—80-2375)
Positive muon and the positron as probes of defects, 5:34249 (BNL—28196)
METALS/ULTRASONIC TESTING
Crack depth determination by ultrasonic frequency analysis aided by dynamic photoelasticity, 5:34045 (IS-T—900)
METHANATION/CATALYSTS
Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980, 5:33183 (DOE/ET/14815—12)
Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
Environmental control in synfuels processes. Catalytic reactions involving synthesis gas, 5:33174
METHANE/ATOM-MOLECULE COLLISIONS
Reactions with oxygen atoms, 5:33922 (BNL—50973)
METHANE/BIOSYNTHESIS
Anaerobic digestion of kelp, 5:33427 (NP—25045)
Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
Energy substitution in rural domestic sector: use of cattle dung as a source of fuel, 5:33426 (NP—25011)
Janata biogas plant, 5:33425 (NP—25010)
METHANE/CHEMICAL REACTION YIELD
Mechanistic study of the hydrogenolysis of neopentane on iridium, 5:33934 (IS-T—909)
Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
METHANOL/ATOM-MOLECULE COLLISIONS
Reactions with oxygen atoms, 5:33922 (BNL—50973)
METHANOL/COMBUSTION KINETICS
Modeling of flame properties of methanol, 5:33358 (CONF-790520—)
METHANOL/COMBUSTION PRODUCTS
Evaluation of methanol for reduced exhaust emissions in a single-cylinder research engine, 5:33843 (CONF-790520—)
METHANOL/COMBUSTION PROPERTIES
Modeling of flame properties of methanol, 5:33358 (CONF-790520—)
METHANOL/COMPARATIVE EVALUATIONS
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
METHANOL/FUEL SUBSTITUTION
Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand, 5:33846 (CONF-790520—)
METHANOL/MIXING
Engine experiments with alcohol/diesel fuel blends, 5:33845 (CONF-790520—)
METHANOL/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
METHANOL/PHYSICAL PROPERTIES
Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—)
METHANOL/PRODUCTION
Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—)
METHANOL/SYNTHESIS
Production of methanol from wood, 5:33363 (CONF-790520—)
METHANOL FUELS/COMBUSTION PRODUCTS
Hardware/software strategies for fuel economy optimization with exhaust emission constraints in methanol fueled automobiles, 5:33847 (CONF-790520—)
METHANOL FUELS/COMPARATIVE EVALUATIONS
Driving cycle comparisons of energy economies and emissions from an alcohol and gasoline fueled vehicle, 5:33844 (CONF-790520—)
METHANOL FUELS/FUEL ECONOMY
Hardware/software strategies for fuel economy optimization with exhaust emission constraints in methanol fueled automobiles, 5:33847 (CONF-790520—)
METHANOL PLANTS/ECONOMIC ANALYSIS
Comparative economic analysis of alcohol fuels production options, 5:33362 (CONF-790520—)
Production of methanol from wood, 5:33363 (CONF-790520—)
MHD CHANNELS/END EFFECTS
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
MHD CHANNELS/FLOW MODELS
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
MHD GENERATORS/FLOW MODELS
Calculations of flows in MHD channels. US-USSR cooperative program in MHD power generation. Scientific technical report, No. 78/1, 5:33746 (CONF-781009—2)
MICA/ABUNDANCE
Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
MICELLAR-POLYMER FLOODING
See MICROEMULSION FLOODING
MICHIGAN/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
MICHIGAN/RESOURCE ASSESSMENT
Dow true in situ process for recovery of energy from the Antrim shale, 5:33294
MICROBIAL FLORA
See MICROORGANISMS

MICROELECTRONIC CIRCUITS/DESIGN
Current-switched full adder fabricated by photolithographic techniques, 5:34015
High-performance Josephson interferometer latching logic and power supplies, 5:34017
MICROELECTRONIC CIRCUITS/FABRICATION
Advanced imaging techniques for submicrometer devices, 5:33992
High resolution electron beam lithography and applications to superconducting devices, 5:33993
Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
Memory device utilizing the storage of Abrikosov vortices at an array of pinning sites in a superconducting film, 5:34016
MICROELECTRONIC CIRCUITS/JOSEPHSON JUNCTIONS
Fast superconducting instruments, 5:34020
MICROELECTRONIC CIRCUITS/MEETINGS
Future trends in superconductive electronics, (Charlottesville, 1978), 5:33961
MICROELECTRONIC CIRCUITS/PERFORMANCE
Current-switched full adder fabricated by photolithographic techniques, 5:34015
High temperature hybrids for use up to 275°C - drift and lifetime, 5:33565 (SAND—80-0444C)
Memory device utilizing the storage of Abrikosov vortices at an array of pinning sites in a superconducting film, 5:34016
MICROELECTRONIC CIRCUITS/QUALITY ASSURANCE
Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
MICROEMULSION FLOODING/DEMONSTRATION PROGRAMS
Big Muddy Field low tension flood demonstration project. Second annual report, April 1979-March 1980, 5:33246 (DOE/SF/01424—26)
MICROEMULSION FLOODING/RESEARCH PROGRAMS
Tertiary oil recovery processes. Annual report, October 1978-September 1979, 5:33243 (DOE/BC/20001—6)
MICROEMULSION FLOODING/SURFACTANTS
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)
MICROFLORA
See MICROORGANISMS
MICROORGANISMS/GROWTH
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
MICROORGANISMS/RADIOSENSITIVITY
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
MICROPROCESSORS/MANUALS
SLAC/RAI LSI-11/2 construction/configuration guide, 5:34450 (SLAC-TN—80-2)
MICROSPHERES/ETCHING
Surface treatment of lead glass microsphere, 5:33343 (UCRL—83398)
MICROSPHERES/LEACHING
Surface treatment of lead glass microsphere, 5:33343 (UCRL—83398)
MICROTRONS/SPECIFICATIONS
NBS-LASL racetrack microtron, 5:34083 (LA-UR—80-1856)
MICROWAVE AMPLIFIERS/MAGNETRONS
Relativistic electron beam crossed-field device (Patent), 5:34242
MICROWAVE DRYERS/DESIGN
Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
MICROWAVE DRYERS/ENERGY CONSERVATION
Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
MICROWAVE RADIATION/BIOLOGICAL RADIATION EFFECTS
Effect of microwaves on the immune system. Technical report, 5:34189 (AD-A—076768)
MIDDLE EAST/PETROLEUM
International energy indicators, 5:33663 (DOE/IA—0010/2)
MILITARY FACILITIES/WIND POWER PLANTS
Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report, 5:33586 (AD-A—076975)
MILL TAILINGS/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
MILL TAILINGS/RADIOCHEMICAL ANALYSIS
Asphalt emulsion sealing of uranium mill tailings. 1979 annual report, 5:33317 (PNL—3290)
MILL TAILINGS/STABILIZATION
Asphalt emulsion sealing of uranium mill tailings. 1979 annual report, 5:33317 (PNL—3290)
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
MINE-MOUTH GENERATING PLANTS
See COAL MINES
FOSSIL-FUEL POWER PLANTS
MINERAL CYCLING/SOILS
Mineral cycling in soil and litter arthropod food chains. Progress report, November 1, 1979-October 31, 1980, 5:34149 (DOE/EV/00641—37)
MINERAL INDUSTRY
See also COAL INDUSTRY
METAL INDUSTRY
OIL SHALE INDUSTRY
PETROLEUM INDUSTRY
MINERAL INDUSTRY/DIRECTORIES
Directory of Washingto.. mining operations, 1979, 5:33682
MINERAL RESOURCES/ECONOMICS
Minerals in the economy of Missouri, 5:33683
Minerals in the economy of Wyoming, 5:33684
Minerals in the economy of Utah, 5:33685
Minerals in the economy of Illinois, 5:33686
MINERAL RESOURCES/PRODUCTION
Minerals in the economy of Missouri, 5:33683
Minerals in the economy of Wyoming, 5:33684
Minerals in the economy of Utah, 5:33685
Minerals in the economy of Illinois, 5:33686
MINERAL VA. NORTH ANNA-1 REACTOR
See NORTH ANNA-1 REACTOR
MINERAL WASTES/WASTE PRODUCT UTILIZATION
Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979, 5:33219 (DOE/ET/10533—9)
MINING
See also OIL SHALE MINING
SURFACE MINING
UNDERGROUND MINING
MINING/DIRECTORIES
Directory of Washington mining operations, 1979, 5:33682
MINING/RESEARCH PROGRAMS
Minerals environmental in-house and contract research and development in fiscal year 1980, 5:34147 (BM-IC—8827)
MINNESOTA/CO-GENERATION
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
District-heating/cogeneration symposium, 5:33803 (CONF-790401—)
Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—)
Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—)
Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—)
St. Paul district-heating study, 5:33808 (CONF-790401—)
Twin Cities institutional issues study: cogenerated hot-water district heating, 5:33807 (CONF-790401—)
University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—)
MINNESOTA/DISTRICT HEATING
Conversion of existing buildings in the Twin Cities to a hot-water system, 5:33811 (CONF-790401—)
District-heating/cogeneration symposium, 5:33803 (CONF-790401—)
Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—)
Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—)
Feasibility of a large-scale cogeneration/hot-water district-heating system in the Twin Cities, 5:33806 (CONF-790401—)
Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—)
Overview of Twin Cities district-heating studies, 5:33805 (CONF-790401—)
St. Paul district-heating study, 5:33808 (CONF-790401—)
Twin Cities institutional issues study: cogenerated hot-water district heating, 5:33807 (CONF-790401—)
MINNESOTA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
MINNESOTA/ICES
University of Minnesota Grid-Connected Integrated Community Energy System, 5:33758 (CONF-790401—)
MINORITY GROUPS
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
MINORITY GROUPS/EDUCATION
Training migrant and seasonal farmworkers for energy-related occupations, 5:33817 (ORAU—170)

MIRRORS/FABRICATION
Stressed mirror polishing. 1: A technique for producing nonaxisymmetric mirrors, 5:34386
Stressed mirror polishing. 2: Fabrication of an off-axis section of a paraboloid, 5:33943
MIRRORS/POLISHING
Stressed mirror polishing. 1: A technique for producing nonaxisymmetric mirrors, 5:34386
Stressed mirror polishing. 2: Fabrication of an off-axis section of a paraboloid, 5:33943
MISCIBLE FLOODING
See MISCIBLE-PHASE DISPLACEMENT
MISCIBLE-PHASE DISPLACEMENT
See also MICROEMULSION FLOODING
MISCIBLE-PHASE DISPLACEMENT/DISPLACEMENT RATES
Random choice method for calculating fluid displacement in a porous medium, 5:33247 (LBL—11086)
MISSILES/TEST FACILITIES
Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
MISSISSIPPI/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
MISSOURI
Cogeneration of electricity in the St. Louis region: industrial potential, 5:33797 (CUERS-Report—10)
MISSOURI/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
MISSOURI/MINERAL RESOURCES
Minerals in the economy of Missouri, 5:33683
MISSOURI/RESIDENTIAL SECTOR
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)
MISSOURI/TRANSPORTATION SECTOR
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)
MIUS
(Modular Integrated Utility Systems.)
MIUS/FEASIBILITY STUDIES
Application of Modular Integrated Utility Systems (MIUS) concept as a strategy for urban rehabilitation and redevelopment, 5:33813 (ORNL/HUD/MIUS—53)
MM-0011
See ALLOY-MM-0011
MODELS (NUCLEAR)
See NUCLEAR MODELS
MODELS (SHELL)
See SHELL MODELS
MODIFIED IN-SITU PROCESSES/MATHEMATICAL MODELS
Model capabilities for in-situ oil shale recovery, 5:33293 (SAND—80-1873C)
MODULAR INTEGRATED UTILITY SYSTEMS
See MIUS
MOLECULAR STRUCTURE/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
MOLLUSCS/DIGESTION
Investigating the impact of drilling mud and its major components on bivalve species of Georges Bank. Progress report, March 1, 1979-February 29, 1980, 5:34204 (DOE/EV/04580—T1)
MOLLUSCS/MORPHOLOGICAL CHANGES
Investigating the impact of drilling mud and its major components on bivalve species of Georges Bank. Progress report, March 1, 1979-February 29, 1980, 5:34204 (DOE/EV/04580—T1)
MOLTEN CARBONATE FUEL CELLS/CATHODES
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
MOLTEN CARBONATE FUEL CELLS/DESIGN
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
MOLTEN CARBONATE FUEL CELLS/MATERIALS TESTING
High temperature fuel cell research and development. Final technical status report, 1 March 1979-31 March 1980, 5:33755 (DOE/ET/11320—T1)
MOLTEN CARBONATE FUEL CELLS/MATHEMATICAL MODELS
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
MOLTEN CARBONATE FUEL CELLS/MATRIX MATERIALS
Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
Fuel cell research on second-generation molten-carbonate systems. Project 61021. Final report, October 1, 1978-January 31, 1980, 5:33754 (SAN—11276-4)
High temperature fuel cell research and development. Final technical status report, 1 March 1979-31 March 1980, 5:33755 (DOE/ET/11320—T1)
MOLTEN CARBONATE FUEL CELLS/PERFORMANCE TESTING
Advanced fuel cell development. Progress report, October-December 1979, 5:33748 (ANL—80-33)
MOLYBDENUM/CATALYTIC EFFECTS
Cobalt-molybdenum-alumina desulfurization catalyst (Patent), 5:33254
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
MOLYBDENUM/CHEMICAL VAPOR DEPOSITION
Chemical vapor deposited molybdenum films for use in photothermal conversion, 5:33533
MOLYBDENUM/CORROSION RESISTANCE
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
MOLYBDENUM/ELECTROPLATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
MOLYBDENUM/PHYSICAL RADIATION EFFECTS
Effect of He on the swelling/microstructure produced in Mo by ion bombardment, 5:33891
MOLYBDENUM/REFLECTIVITY
Chemical vapor deposited molybdenum films for use in photothermal conversion, 5:33533
MOLYBDENUM/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
MOLYBDENUM/SURFACE PROPERTIES
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
MOLYBDENUM/TOXICITY
Possible adverse effects of trace materials, 5:34206 (BNL—51118)
MOLYBDENUM 94 TARGET/NEUTRON REACTIONS
Studies of (n, charged particle) reactions with 14 to 15 MeV neutrons, 5:34335 (UCID—18577)
MOLYBDENUM ALLOYS/ELECTRIC CONDUCTIVITY
Resistivity due to hydrogen in transition metal alloys, 5:33882
MOLYBDENUM ALLOYS/PHYSICAL RADIATION EFFECTS
Effects of radiation-induced segregation and preferential sputtering on the sputtering rate of alloys, 5:33896
MOLYBDENUM BORIDES/COLD WORKING
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
MOLYBDENUM BORIDES/MAGNETIC FLUX
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
MOLYBDENUM BORIDES/SUPERCONDUCTIVITY
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
MONJU REACTOR/BELLOWS
Bellows for control rod drive mechanism of MONJU, 5:33630 (JAPFNR—508)
MONJU REACTOR/CONTROL ROD DRIVES
Bellows for control rod drive mechanism of MONJU, 5:33630 (JAPFNR—508)
MONOCHROMATORS/SMALL ANGLE SCATTERING
New small-angle neutron scattering (SANS) instrument at ORNL using a position-sensitive area detector, 5:34090
MONTANA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
MONTMORILLONITE/SORPTIVE PROPERTIES
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
MO-RE 2
See ALLOY-MO-RE-2
MOS TRANSISTORS/FABRICATION
Semiconductor chip processing. Final report, 5:34052 (BDX—613-2466)
MULTIPHASE FLOW/MEASURING METHODS
Evaluation of a Coriolis mass flow meter for pulverized coal flows, 5:33745 (DOE/ET/10815—T2)
MUNICIPAL WASTES
See also REFUSE DERIVED FUELS

MUNICIPAL WASTES/ANAEROBIC DIGESTION
Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
MUNICIPAL WASTES/COMBUSTION
New technological developments in processing solid waste to energy, 5:33815
MUNICIPAL WASTES/ENERGY RECOVERY
Energy Recovery from Waste and Biomass Project, 5:34062
MUNICIPAL WASTES/EXPLOSIONS
Causes and alleviation of explosions in solid waste shredders, 5:34061
MUNICIPAL WASTES/MATERIALS RECOVERY
Energy Recovery from Waste and Biomass Project, 5:34062
MUNICIPAL WASTES/RESOURCE POTENTIAL
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
MUNICIPAL WASTES/WASTE MANAGEMENT
New technological developments in processing solid waste to energy, 5:33815
MUNICIPAL WASTES/WASTE PROCESSING
Causes and alleviation of explosions in solid waste shredders, 5:34061
MUON BEAMS/DEPOLARIZATION
Models for positive muon depolarization in spin glasses for zero external field, 5:34275 (LA-UR—80-2371)
MUON PAIRS/PAIR PRODUCTION
Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957)
MUON PROBES/DEPOLARIZATION
Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
Muon spin depolarization in nonmagnetic metals doped with paramagnetic impurities, 5:34253 (LA-UR—80-2375)
MUON PROBES/ELECTRON SPIN RESONANCE
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
MUON PROBES/MATHEMATICAL MODELS
Depolarization of diffusing spins by paramagnetic impurities, 5:34254 (LA-UR—80-2376)
MUON PROBES/USES
Positive muon and the positron as probes of defects, 5:34249 (BNL—28196)
MUON REACTIONS/CAPTURE
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
MUONIC ATOMS/X-RAY SPECTRA
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
MUONIUM/ELECTRON SPIN RESONANCE
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
MUONIUM/HYPERFINE STRUCTURE
Temperature dependence of anomalous muonium hyperfine interactions in silicon, 5:34251 (LA-UR—80-2373)
MUSEUMS
See EDUCATIONAL FACILITIES
MUSSELS
See MOLLUSCS
MUTAGEN SCREENING/ANIMAL CELLS
Quantitative mutagenesis and mutagen screening with Chinese hamster ovary cells, 5:34200 (CONF-800485—1)
MUTAGENS/GENETIC EFFECTS
Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Annual progress report, November 1, 1979 to October 31, 1980, 5:34181 (DOE/EV/00637—9)

N

NATIONAL ACCELERATOR LABORATORY
See FERMILAB ACCELERATOR
NATIONAL ENERGY ACT/EVALUATION
Review and assessment of the National Energy Act: a Missouri perspective, 5:33704
NATURAL GAS/FUEL CONSUMPTION
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
NATURAL GAS/GAS HYDRATES
Methane hydrate as an energy resource. A review with recommended future research, 5:33280 (LA—8368-MS)
NATURAL GAS/IMPORTS
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
NATURAL GAS/MEETINGS
Proceedings of the fifty-ninth annual convention, 5:33279
NATURAL GAS/PROCESSING
Acid gas removal by versatile Shell processes (Sulfinol; ADIP), 5:33283
NATURAL GAS/PRODUCTION
Technological status, economics and adoption prospects of major coal synthetic pipeline gas processes, 5:33176
NATURAL GAS/REGULATIONS
Oil ang gas: general rules and regulations, 5:33705
NATURAL GAS/STATISTICS
Mineral oil statistics 1979 for the Federal Republic of Germany with comparative figures for January/December 1978, 5:33268 (NP—24979)
NATURAL GAS DEPOSITS/ENERGY SOURCE DEVELOPMENT
Future role of geopressured resources in US energy policy: a scenario approach and analysis Final report, July 1, 1978-March 31, 1979, 5:33286 (COO—4955-1)
NATURAL GAS DEPOSITS/HYDRAULIC FRACTURING
Western Gas Sands Project. Status report, 1 May-31 May, 1980, 5:33285 (DOE/BC/10003—10)
NATURAL GAS DEPOSITS/LEASING
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
NATURAL GAS INDUSTRY
Annual report, 1979 (In German), 5:33707 (NP—25049)
NATURAL GAS INDUSTRY/LEGISLATION
General order prescribing rules and regulations governing the conservation of oil and gas in Alabama and oil and gas laws of Alabama with Oil and Gas Board forms, 5:33273
NATURAL GAS INDUSTRY/REGULATIONS
General order prescribing rules and regulations governing the conservation of oil and gas in Alabama and oil and gas laws of Alabama with Oil and Gas Board forms, 5:33273
NATURAL GAS PROCESSING PLANTS
Amine gas treating solution analysis: a tool in problem solving, 5:33281
NATURAL GAS PROCESSING PLANTS/ENVIRONMENTAL IMPACT STATEMENTS
Prudhoe Bay Project. Final Environmental Impact Statement: Docket No. CP78-123 et al., 5:33284 (FERC/EIS—0009)
NATURAL GAS PROCESSING PLANTS/SELEXOL PROCESS
High CO_2-high H_2S removal with SELEXOL solvent, 5:33282
NATURAL GAS PROCESSING PLANTS/SOLAR PROCESS HEAT
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Executive summary. Final report, 5:33496 (DOE/SF/10736—1/1)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Technical report. Final report, 5:33497 (DOE/SF/10736—1/2)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Appendices. Final report, 5:33498 (DOE/SF/10736—1/3)
NATURAL GAS WELLS/WELL DRILLING
Procedures for permit to drill for oil and gas in the Commonwealth of Virginia, 5:33702
NEBRASKA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
NEODYMIUM BASE ALLOYS/ANTIFERROMAGNETISM
Observation of an unusual magnetic phase transition in $NdSn_3$, 5:33873
NEODYMIUM BASE ALLOYS/MAGNETIC SUSCEPTIBILITY
Observation of an unusual magnetic phase transition in $NdSn_3$, 5:33873
NEODYMIUM LASERS/REVIEWS
High-power pulsed lasers, 5:34427 (UCRL—52868)
NEON/ATOM-ATOM COLLISIONS
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
NEON/ION-ATOM COLLISIONS
Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment (1 MeV/amu), 5:34258
NEON 16/MASS
Isospin quintets in the 1p and s-d shells, 5:34318
NEON 20 REACTIONS
Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361

NEON 20 TARGET/NEON 20 REACTIONS
Classical-equations-of-motion calculations of high-energy heavy-ion collisions, 5:34361
NEON IONS/ION-ATOM COLLISIONS
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
NEOPENTANE
See 2-2-DIMETHYLPROPANE
NEOPLASMS/RADIOINDUCTION
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
NERVE CELLS/CELL CULTURES
Cell culture systems to study glial transformation, 5:34178 (UCLA—12-1261)
NETWORKS (COMPUTER)
See COMPUTER NETWORKS
NEURONS
See NERVE CELLS
NEUTRAL BEAM SOURCES
See also ION SOURCES
NEUTRAL BEAM SOURCES/RESEARCH PROGRAMS
Neutral beam development at the Lawrence Berkeley and Lawrence Livermore Laboratories, 5:34416 (LBL—11141)
NEUTRINO REACTIONS/COHERENT PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
NEUTRINO REACTIONS/MULTIPLE PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
NEUTRON BEAMS/POLARIZED BEAMS
Polarized targets and polarized low energy neutrons at WNR, 5:34366 (LA-UR—80-1933)
NEUTRON BEAMS/POLARIZED TARGETS
Polarized targets and polarized low energy neutrons at WNR, 5:34366 (LA-UR—80-1933)
NEUTRON CAPTURE
See NEUTRON BEAMS
NEUTRON DETECTION/NEUTRON MONITORS
Response of a fast neutron criticality monitor to prompt critical bursts, 5:34092
NEUTRON DETECTION/PROPORTIONAL COUNTERS
Tissue equivalent proportional counter neutron monitor, 5:34088 (HEDL-SA—2041)
NEUTRON DETECTORS/MONOCHROMATORS
New small-angle neutron scattering (SANS) instrument at ORNL using a position-sensitive area detector, 5:34090
NEUTRON MONITORS/ALARM SYSTEMS
Response of a fast neutron criticality monitor to prompt critical bursts, 5:34092
NEUTRON REACTIONS/CAPTURE
Non-statistical effects in neutron reactions on ^{32}S, 5:34324
NEUTRON REACTIONS/CHARGE-EXCHANGE REACTIONS
Studies of (n, charged particle) reactions with 14 to 15 MeV neutrons, 5:34335 (UCID—18577)
NEUTRON REACTIONS/COHERENT PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
NEUTRON REACTIONS/CROSS SECTIONS
Graphs of the cross sections in the Alternate Monte Carlo Cross Section library at the Los Alamos Scientific Laboratory, 5:34346 (LA—8394-MS)
NEUTRON REACTIONS/ELASTIC SCATTERING
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, 15 to 40 MeV), 5:34337
NEUTRON REACTIONS/FAST FISSION
Fission neutron multiplicity for /sup 242m/Am (0 to 30 MeV), 5:34348 (UCID—18577)
NEUTRON REACTIONS/FISSION
Fission cross section of ^{245}Cm (10 to 32 eV), 5:34347 (UCID—18577)
Time dependent beta-delayed neutrons from fissioning systems, 5:34349 (UCID—18577)
NEUTRON REACTIONS/INELASTIC SCATTERING
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, 15 to 40 MeV), 5:34337
NEUTRON REACTIONS/MULTIPLE PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
NEUTRON REACTIONS/THERMAL FISSION
Fission cross section of ^{245}Cm (10 to 32 eV), 5:34347 (UCID—18577)
NEUTRON REACTIONS/TOTAL CROSS SECTIONS
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, 15 to 40 MeV), 5:34337
Neutron total cross section for tritium (60 keV to 80 MeV), 5:34314 (UCID—18577)
NEUTRON SOURCES
(Excludes reactors even when used as neutron sources.)
NEUTRON SOURCES/ACCELERATOR FACILITIES
10^{13}/second 14 MeV neutron generator for cancer therapy, 5:34084 (SAND—80-1388C)
NEUTRON SOURCES/SPECIFICATIONS
10^{13}/second 14 MeV neutron generator for cancer therapy, 5:34084 (SAND—80-1388C)
NEUTRON STARS/EQUATIONS OF STATE
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
NEUTRON STARS/MASS
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
NEUTRON STARS/ORIGIN
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
NEUTRONS
See also FISSION NEUTRONS
NEUTRONS/OSCILLATIONS
Neutron oscillations and the existence of massive neutral leptons, 5:34297
NEVADA/GRAVITY SURVEYS
Complete Bouguer gravity map of the Tonopah 1° x 2° quadrangle, Nevada, 5:34224 (USGS-OFR—80-611)
NEVADA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
NEVADA/MAPS
Complete Bouguer gravity map of the Tonopah 1° x 2° quadrangle, Nevada, 5:34224 (USGS-OFR—80-611)
NEVADA/POWER PLANTS
Principal electric facilities: Arizona, California, Nevada, 5:33711 (DOE/EIA—0057/9(79))
NEVADA TEST SITE/NUCLEAR EXPLOSIONS
Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979, 5:34108 (USGS-OFR—80-817)
NEVADA TEST SITE/RADIOACTIVE WASTE MANAGEMENT
Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979, 5:34108 (USGS-OFR—80-817)
NEW ENGLAND
See NORTH ATLANTIC REGION
NEW HAMPSHIRE/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
NEW HAMPSHIRE/WIND POWER PLANTS
Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report, 5:33586 (AD-A—076975)
NEW JERSEY/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
NEW MEXICO/AIR QUALITY
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
NEW MEXICO/ENERGY CONSUMPTION
Attitudes toward energy use and policy in New Mexico, 5:33818
NEW MEXICO/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
NEW MEXICO/LITHOLOGY
Basic data report for drillhole WIPP 30 (Waste Isolation Pilot Plant - WIPP), 5:33330 (SAND—79-0284)
NEW MEXICO/METEOROLOGY
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
NEW YORK/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
NICKEL/ADSORBENTS
Further studies of Ni (001)c(2 x 2)CO: Evidence for back donation in the chemisorption bond, 5:33879
NICKEL/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251

Selective hydrocracking process for middle distillate (Patent), 5:33252
NICKEL/CREEP
Light ion irradiation-induced creep mechanisms in nickel, 5:33900
NICKEL/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
NICKEL/PHYSICAL RADIATION EFFECTS
Light ion irradiation-induced creep mechanisms in nickel, 5:33900
Microstructure and tensile properties of T(d,n) and Be (d,n) neutron irradiated nickel, niobium and 316SS, 5:33895
NICKEL/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
NICKEL/SURFACE COATING
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
NICKEL 58 TARGET/TRITON REACTIONS
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
NICKEL 60 TARGET/TRITON REACTIONS
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
NICKEL 62 TARGET/TRITON REACTIONS
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
NICKEL 64 TARGET/TRITON REACTIONS
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
NICKEL ALLOYS
See also NICKEL BASE ALLOYS
NICKEL ALLOYS/DEHYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
NICKEL ALLOYS/HYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
NICKEL ALLOYS/PHYSICAL RADIATION EFFECTS
Effect of nickel and nitrogen on void formation in ion bombarded vanadium, 5:33897
Gamma prime hardened nickel-iron based superalloy (Patent), 5:33889
NICKEL ALLOYS/SURFACE PROPERTIES
Normal emission photoelectron diffraction: a new technique for determining surface structure, 5:34099 (LBL—11017)
NICKEL BASE ALLOYS
See also ALLOY-MM-0011
ALLOY-MO-RE-2
ALLOY-NX-188
INCONEL 713LC
RENE 80
RENE-100
NICKEL BASE ALLOYS/CORROSION
High-temperature oxidation and corrosion of materials program, 5:33888 (LBL—11202)
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
NICKEL BASE ALLOYS/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
NICKEL BASE ALLOYS/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
NICKEL BASE ALLOYS/OXIDATION
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
NICKEL BASE ALLOYS/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
NICKEL BASE ALLOYS/PHYSICAL RADIATION EFFECTS
Effects of radiation-induced segregation and preferential sputtering on the sputtering rate of alloys, 5:33896
NICKEL BASE ALLOYS/SURFACE PROPERTIES
Al_2O_3 adherence on CoCrAl alloys, 5:33868 (LBL—10952)
NICKEL-CADMIUM BATTERIES/ANODES
Nickel-cadmium cell and method for precharging negative electrode of nickel-cadmium alkaline storage cell (Patent), 5:33649
NICKEL-CADMIUM BATTERIES/CATHODES
Fabrication of alkaline batteries (Patent), 5:33654
NICKEL-CADMIUM BATTERIES/MANUFACTURING
Nickel-cadmium cell and method for precharging negative electrode of nickel-cadmium alkaline storage cell (Patent), 5:33649
NICKEL-HYDROGEN BATTERIES/CATHODES
Fabrication of alkaline batteries (Patent), 5:33654
NICKEL-ZINC BATTERIES/CATHODES
Fabrication of alkaline batteries (Patent), 5:33654
NICKEL-ZINC BATTERIES/OPTIMIZATION
Methods for perfecting nickel-zinc storage batteries for the power plants of electric automobiles, 5:33826 (DOE-tr—231)
NICKEL-ZINC BATTERIES/PERFORMANCE TESTING
Methods for perfecting nickel-zinc storage batteries for the power plants of electric automobiles, 5:33826 (DOE-tr—231)
NIOBIUM/PHYSICAL RADIATION EFFECTS
Microstructure and tensile properties of T(d,n) and Be (d,n) neutron irradiated nickel, niobium and 316SS, 5:33895
NIOBIUM ALLOYS
See also NIOBIUM BASE ALLOYS
NIOBIUM ALLOYS/ELECTRIC CONDUCTIVITY
Resistivity due to hydrogen in transition metal alloys, 5:33882
NIOBIUM ALLOYS/NEUTRON DIFFRACTION
Study of the temperature dependence of the localized vibrations of H and D in niobium, 5:33856
NIOBIUM ALLOYS/ORDER-DISORDER TRANSFORMATIONS
Study of the temperature dependence of the localized vibrations of H and D in niobium, 5:33856
NIOBIUM BASE ALLOYS/PROXIMITY EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
NIOBIUM BASE ALLOYS/SUPERCONDUCTIVITY
LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980, 5:34379 (LA—8446-PR)
NIOBIUM BASE ALLOYS/TUNNEL EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
NIOBIUM COMPOUNDS/SPUTTERING
Surfaces of high-T/sub c/ Nb_3Ge films as studied by electron tunneling and auger electron spectroscopy, 5:34009
NITINOL/SHAPE MEMORY EFFECT
Comments on the thermal efficiency of an ideal shape-recovery cycle, 5:33864
NITRIC ACID/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
NITROGEN 15 REACTIONS/COMPOUND-NUCLEUS REACTIONS
Nonstatistical effects in the $^{13}C(^{15}N,\alpha)$ reaction, 5:34322
NITROGEN 15 TARGET/PROTON REACTIONS
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
NITROGEN COMPOUNDS/RAMAN SPECTRA
Raman scattering from NH_4^+ and ND_4^+ in beta-alumina, 5:34245
NITROGEN HYDRIDES/RAMAN SPECTRA
Raman scattering from NH_4^+ and ND_4^+ in beta-alumina, 5:34245
NITROGEN IONS/ION-ATOM COLLISIONS
Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment (1 MeV/amu), 5:34258
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
NITROUS OXIDE/RESPONSE MODIFYING FACTORS
Distinction between the roles of O_2 and of O^-_2 in biological radiodamage, 5:34184 (DOE/EV/03221—68)
NOBLE GASES
See RARE GASES
NONAXIAL NUCLEI
See DEFORMED NUCLEI
NORTH ANNA-1 REACTOR/ENGINEERED SAFETY SYSTEMS
Technical evaluation of the proposed technical specification change for the North Anna Nuclear Power Station, Unit 1, 5:33626 (UCID—18672)
NORTH ANNA-1 REACTOR/REACTOR PROTECTION SYSTEMS
Technical evaluation of the proposed technical specification change for the North Anna Nuclear Power Station, Unit 1, 5:33626 (UCID—18672)
NORTH ATLANTIC REGION
See also CONNECTICUT
MAINE
MASSACHUSETTS
NEW HAMPSHIRE
RHODE ISLAND
VERMONT

NORTH ATLANTIC REGION/WIND POWER
A feasibility study of windpower for the New England area. Final technical report, 4 June-31 October 1979, 5:33583 (AD-A—076614)
NORTH CAROLINA
Directory of North Carolina energy-resource personnel, 5:33816 (NCEI—0017)
NORTH CAROLINA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
NORTH CAROLINA/INSOLATION
Coastal-inland solar radiation difference study. Final report, 5:33381 (DOE/ET/20174—1)
NORTH DAKOTA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
NORTHERN IRELAND
See UNITED KINGDOM
NUCLEAR EXPLOSIONS
See also UNDERGROUND EXPLOSIONS
NUCLEAR EXPLOSIONS/BIOLOGICAL RADIATION EFFECTS
Nomograms for overpressure, fireball radius and thermal energy of nuclear weapons. Technical information series, 5:34107 (AD-A—076489)
NUCLEAR EXPLOSIONS/BLAST EFFECTS
Nomograms for overpressure, fireball radius and thermal energy of nuclear weapons. Technical information series, 5:34107 (AD-A—076489)
NUCLEAR FACILITIES
See also FEED MATERIALS PLANTS
FUEL FABRICATION PLANTS
FUEL REPROCESSING PLANTS
IRRADIATION PLANTS
NUCLEAR POWER PLANTS
RADIOACTIVE WASTE FACILITIES
NUCLEAR FACILITIES/CHEMICAL EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
NUCLEAR FACILITIES/RADIOACTIVE EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
NUCLEAR INDUSTRY/MARKETING RESEARCH
Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
NUCLEAR MATERIALS MANAGEMENT/ACCOUNTING
DYMAC digital electronic balance (LASL Plutonium Processing Facility), 5:33342 (LA—8313-M)
NUCLEAR MATTER/COMPRESSIBILITY
Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions, 5:34358 (LBL—8957)
NUCLEAR MATTER/EQUATIONS OF STATE
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
Asymptotic freedom and dense baryonic matter, 5:34353
Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions, 5:34358 (LBL—8957)
NUCLEAR MATTER/PION CONDENSATION
Indication for the formation of strongly compressed nuclear matter in relativistic heavy ion collisions, 5:34358 (LBL—8957)
NUCLEAR MEDICINE
See also BIOMEDICAL RADIOGRAPHY
RADIOPHARMACEUTICALS
RADIOTHERAPY
SCINTISCANNING
NUCLEAR MEDICINE/DIAGNOSIS
Quality control of software in dissimilar systems using a common clinical data base, 5:34173 (DOE/EV/10343—4)
NUCLEAR MODELS
See also LIQUID DROP MODEL
SHELL MODELS
NUCLEAR MODELS/COMPARATIVE EVALUATIONS
Critical analysis of models for high-energy hadron-nucleus interactions, 5:34363 (LBL—8957)
NUCLEAR PHYSICS/RESEARCH PROGRAMS
Status report to DOE Nuclear Data Committee, 5:34309 (UCID—18577)
NUCLEAR POWER/CAPACITY
International energy indicators, 5:33663 (DOE/IA--0010/2)
NUCLEAR POWER/ENERGY POLICY
Nuclear power: in perspective, 5:33689 (CONF-800212—)
NUCLEAR POWER/SOCIO-ECONOMIC FACTORS
Nuclear power: in perspective, 5:33689 (CONF-800212—)
NUCLEAR POWER PLANTS/COST
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
NUCLEAR POWER PLANTS/FUEL CYCLE
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
NUCLEAR POWER PLANTS/REACTOR INSTRUMENTATION
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
NUCLEAR POWER PLANTS/SEISMIC EFFECTS
Development of the seismic input for use in the seismic safety margins research program, 5:33634 (UCRL—81944)
NUCLEAR PROPERTIES/NUCLEAR DATA COLLECTIONS
Recent references, 5:34310
NUCLEAR REACTIONS
See also HADRON REACTIONS
NUCLEAR REACTIONS/LECTURES
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
NUCLEAR REACTIONS/NUCLEAR DATA COLLECTIONS
Recent references, 5:34310
NUCLEAR STRUCTURE
Generalized Fermi sea for plane-wave Hartree-Fock theory. II. Semirealistic interactions in three dimensions, 5:34350
NUCLEAR WASTES
See RADIOACTIVE WASTES
NUCLEAR WEAPON TESTS
See NUCLEAR EXPLOSIONS
NUCLEASE (DEOXYRIBONUCLEASE)
See DNA-ASE
NUCLEASES/CHEMICAL PROPERTIES
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
NUCLEASES/MOLECULAR STRUCTURE
Comprehensive progress report, 1977-1980, 5:34168 (DOE/EV/03083—T1)
NUCLEASES/PURIFICATION
Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation. Scientific progress report, 5:34169 (DOE/EV/02814—1)
NUCLEI
See also DEFORMED NUCLEI
EVEN-EVEN NUCLEI
LIGHT NUCLEI
NUCLEI/FORM FACTORS
Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957)
NUCLEI/WAVE FUNCTIONS
Nuclear phenomena and the short distance structure of hadrons, 5:34359 (LBL—8957)
NUCLEONS
See also NEUTRONS
NUCLEONS/QUARK MODEL
Role of valons in low-p/sub T/ physics, 5:34293 (LA-UR—80-2235)
NUTRIENTS/RECYCLING
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)
NUTS (SEEDS)
See SEEDS
NX-188
See ALLOY-NX-188

O

OCCUPATIONS/WAGES
Generation of the industry/occupation wage matrix and related matters. Final report, 5:33671 (DOE/CS/20258—2)
Job shifts from energy conservation: salary distribution effects. Final report, 5:33693 (DOE/CS/20258—2)
OCEAN THERMAL ENERGY CONVERSION/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
OCEAN THERMAL ENERGY CONVERSION/ENVIRONMENTAL IMPACTS
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)

OCEAN THERMAL ENERGY CONVERSION/HEAT EXCHANGERS
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)
OCEAN THERMAL ENERGY CONVERSION/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
OCEAN THERMAL ENERGY CONVERSION/TEST FACILITIES
OTEC-1 Power System Test Program: test plan for first deployment, 5:33457 (ANL/OTEC-PS—6)
OCEAN THERMAL POWER PLANTS/DESIGN
Report of ad hoc OTEC cold water pipe committee, 5:33458 (DOE/ET/21002—2)
OCEAN THERMAL POWER PLANTS/PIPES
Report of ad hoc OTEC cold water pipe committee, 5:33458 (DOE/ET/21002—2)
OCEANOGRAPHY/RESEARCH PROGRAMS
Energy-related perturbations of the northeast coastal zone: five years (1974-1979) of oceanographic research at Brookhaven National Laboratory, 5:34163 (BNL—51211)
OCEANS
See SEAS
OFFICE BUILDINGS/BUILDING CODES
Energy conservation standards for new nonresidential buildings, 5:33784
OFFICE BUILDINGS/SOLAR SPACE HEATING
Solar space heating for the visitors' center, Stephens College, Columbia, Missouri. Final report, 5:33467 (DOE/NASA/CR—161485)
OFF-PEAK ENERGY STORAGE/ELECTRIC BATTERIES
Electrically rechargeable battery (Patent; Zn anode with circulating ferricyanide salt; 35 mA/cm², 1.4 V, 91% efficient), 5:33643
OFF-PEAK ENERGY STORAGE/ZINC-CHLORINE BATTERIES
Rechargeable zinc halogen battery (Patent), 5:33651
OFFSHORE PLATFORMS/PIPES
Retrievable plug for offshore platforms (Patent), 5:34025
OFFSHORE SITES/BIDS
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
OHIO/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
OIL FIELDS/GROUND WATER
Geochemistry of China's oilfield water discussed, 5:33271 (JPRS—75887)
OIL SAND PROCESSING PLANTS/PLUMES
Dispersion modeling of a plume in the tar sands area. Syncrude environmental research report, 1980-1981, 5:34127 (NP—25069)
OIL SANDS/REVERSE COMBUSTION
Analysis of reverse combustion in tar sands: a one-dimensional model, 5:33290 (DOE/LETC—1761-2/1)
OIL SANDS/STEAM INJECTION
Effects of insulation for the steam string of the TS-1S experiment, 5:33292 (SAND—80-0777)
OIL SHALE DEPOSITS/EXPLORATION
Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology: U.S. Department of Energy cored drill holes Number 4 and 5, Hawkins County, Tennessee, 5:33288 (DOE/METC/10866—18)
OIL SHALE DEPOSITS/GEOLOGY
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL SHALE INDUSTRY
See also MINERAL INDUSTRY
OIL SHALE INDUSTRY/ENVIRONMENTAL IMPACTS
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL SHALE INDUSTRY/MEETINGS
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL SHALE INDUSTRY/REGULATIONS
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL SHALE MINING
See also SURFACE MINING
UNDERGROUND MINING
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL SHALES
See also BLACK SHALES
OIL SHALES/CHEMICAL ANALYSIS
Current methods of oil shale analysis and new developments (NMR), 5:33297
OIL SHALES/HYDROGENATION
OIL SHALES/IN-SITU RETORTING
Dow true in situ process for recovery of energy from the Antrim shale, 5:33294
Energy from the in situ processing Antrim shale: process equipment used in the extraction trials, 5:33291 (FE—2346-74)
OIL SHALES/MASS BALANCE
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
OIL SHALES/MODIFIED IN-SITU PROCESSES
Model capabilities for in-situ oil shale recovery, 5:33293 (SAND 80-1873C)
OIL SHALES/OIL YIELDS
Current methods of oil shale analysis and new developments (NMR), 5:33297
OIL SHALES/PYROLYSIS
Pyrolysis and hydrogenation process (Patent), 5:33180
OIL SHALES/QUANTITATIVE CHEMICAL ANALYSIS
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
OIL SHALES/RETORTING
Synthetic fuels from oil shale: symposium papers, 5:33287
OIL WELLS
See also PETROLEUM
OIL WELLS/MICROEMULSION FLOODING
Big Muddy Field low tension flood demonstration project. Second annual report, April 1979-March 1980, 5:33246 (DOE/SF/01424—26)
Tertiary oil recovery processes. Annual report, October 1978-September 1979, 5:33243 (DOE/BC/20001—6)
OIL WELLS/RESIDUAL PETROLEUM
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
OIL WELLS/STEAM INJECTION
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System, 5:33500 (DOE/SF/10737—1(Exect.Summ.))
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report, 5:33499 (DOE/SF/10737—1)
OIL WELLS/WATERFLOODING
Big Muddy Field low tension flood demonstration project. Second annual report, April 1979-March 1980, 5:33246 (DOE/SF/01424—26)
Enhanced oil recovery by improved waterflooding. Second annual report, 5:33245 (DOE/ET/12065—26)
OIL WELLS/WELL DRILLING
Procedures for permit to drill for oil and gas in the Commonwealth of Virginia, 5:33702
OIL-FILLED CABLES/PERFORMANCE TESTING
Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979, 5:33602 (CONS—3122-T2)
OIL-FILLED CABLES/TEMPERATURE MONITORING
Field validation of cable monitoring and rating system (CMARS) laboratory model. Semi-annual report, 1 May 1979-31 December 1979, 5:33602 (CONS—3122-T2)
OILS
See also CORN OIL
FUEL OILS
PEANUT OIL
SHALE OIL
SOYBEAN OIL
OILS/SOLVENT EXTRACTION
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
OKLAHOMA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
OLEFINS
See ALKENES
OLEORESINS/YIELDS
Paraquat and pine trees in east Tennessee, 5:33438
OPENINGS
See also WINDOWS
OPENINGS/INSPECTION
Inspection considerations for holes 0.040 inch and smaller, 5:33944 (BDX—613-2300)
OPERATING COST/ALLOCATIONS
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
OPTICS/MEETINGS
Optics applied to solar energy IV. Volume 161, 5:33526
OPTICS/NONLINEAR PROBLEMS

ORBITAL SOLAR POWER PLANTS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
ORBITAL SOLAR POWER PLANTS/ENVIRONMENTAL IMPACTS
Investigation of the interaction of an SPS rectenna with its environment, 5:34109 (ANL/EES-TM—93)
OREGON
Gleneden Beach: PUB final report, 5:33730
OREGON/ALCOHOL FUELS
Alcohol Fuels Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33360
OREGON/ENERGY POLICY
Oregon's energy future. Fourth annual report, January 1, 1980, 5:33698
OREGON/ENERGY SUPPLIES
Oregon's energy future. Fourth annual report, January 1, 1980, 5:33698
OREGON/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
OREGON/HYDROELECTRIC POWER PLANTS
Hydro Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33367
OREGON/LOW-HEAD HYDROELECTRIC POWER PLANTS
Hydro Task Force. Final report to the Oregon Alternate Energy Development Commission, 5:33367
OREGON/WIND POWER
Wind Energy Task Force. Final report, 5:33582
OREGON/WIND POWER PLANTS
Wind Energy Task Force. Final report, 5:33582
ORGANIC COMPOUNDS
See also AMINES
CARBOHYDRATES
HYDROCARBONS
ORGANIC NITROGEN COMPOUNDS
ORGANIC OXYGEN COMPOUNDS
ORGANIC SULFUR COMPOUNDS
ORGANIC COMPOUNDS/CHEMICAL REACTIONS
Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens (Patent), 5:33213
ORGANIC COMPOUNDS/FLUID FLOW
Transient solidification in flow into a rod bundle, 5:34038
ORGANIC COMPOUNDS/MASS TRANSFER
Transient solidification in flow into a rod bundle, 5:34038
ORGANIC COMPOUNDS/ROD BUNDLES
Transient solidification in flow into a rod bundle, 5:34038
ORGANIC COMPOUNDS/SEPARATION PROCESSES
Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens (Patent), 5:33213
ORGANIC COMPOUNDS/SOLIDIFICATION
Transient solidification in flow into a rod bundle, 5:34038
ORGANIC COMPOUNDS/WATER
Transient solidification in flow into a rod bundle, 5:34038
ORGANIC NITROGEN COMPOUNDS
See also AMINES
AZIDES
CHLOROPHYLL
HEMOGLOBIN
IMINES
PORPHYRINS
PYRROLES
ORGANIC NITROGEN COMPOUNDS/STRUCTURAL CHEMICAL ANALYSIS
Cyano-arenes produced by combustion of nitrogen-containing fuels, 5:33175
ORGANIC OXYGEN COMPOUNDS
See also CARBOHYDRATES
EPOXIDES
FURANS
ORGANIC OXYGEN COMPOUNDS/CHEMICAL REACTIONS
Method of separating active hydrogen compounds from heterogeneous mixtures also containing compounds which do not contain active hydrogens (Patent), 5:33213
ORGANIC SOLVENTS/COMPARATIVE EVALUATIONS
Effect of solvent quality on coal conversion, 5:33204
ORGANIC SOLVENTS/GAS CHROMATOGRAPHY
Effect of solvent quality on coal conversion, 5:33204
ORGANIC SOLVENTS/HYDROGENATION
Effect of solvent quality on coal conversion, 5:33204
ORGANIC SOLVENTS/INFRARED SPECTRA
Effect of solvent quality on coal conversion, 5:33204
ORGANIC SOLVENTS/NUCLEAR MAGNETIC RESONANCE
Effect of solvent quality on coal conversion, 5:33204
ORGANIC SOLVENTS/RECYCLING
Effect of solvent quality on coal conversion, 5:33204
Novel approach to coal liquefaction utilizing hydrogen sulfide and carbon monoxide, 5:33202
ORGANIC SULFUR COMPOUNDS
See also SULFONATES
ORGANIC SULFUR COMPOUNDS/REMOVAL
Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
ORGANIC WASTES/FLUORESCENCE
Laboratory evaluation of an N_2 laser fluorosensor, 5:34098 (EGG—1183-2369)
OSMIUM/CATALYTIC EFFECTS
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
OSMIUM 182/ROTATIONAL STATES
Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
OSMOTIC POWER PLANTS
See SALINITY GRADIENT POWER PLANTS
OUTER CONTINENTAL SHELF
See CONTINENTAL SHELF
OXIRANS
See EPOXIDES
OXYGEN 12/MASS
Isospin quintets in the 1p and s-d shells, 5:34318
OXYGEN 16/GIANT RESONANCE
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
OXYGEN 16 TARGET/PION PLUS REACTIONS
Isospin quintets in the 1p and s-d shells, 5:34318
OXYGEN 16 TARGET/PROTON REACTIONS
Polarization transfer in inelastic scattering, 5:34319 (LA-UR—80-2427)
OXYGEN IONS/ION-ATOM COLLISIONS
Charge-state correlated cross sections for the production of low-velocity highly charged Ne ions by heavy-ion bombardment (1 MeV/amu), 5:34258
K- and L-shell vacancy sharing between light projectiles and argon targets (30 to 600 keV), 5:34260
OXYMETHYLENE
See FORMALDEHYDE
OZONE/COMBUSTION
Application of an explicit numerical method to a reaction-diffusion system in combustion, 5:33942 (COO—3077-162)
OZONE/ENVIRONMENTAL TRANSPORT
Treatment of dynamical processes in two-dimensional models of the troposphere and stratosphere, 5:34132 (UCID—18771)

P

PACIFIC NORTHWEST REGION
See also ALASKA
IDAHO
OREGON
WASHINGTON
PACIFIC NORTHWEST REGION/INTERCONNECTED POWER SYSTEMS
Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system, 5:33741 (P—500-80-019)
Revised draft environmental impact statement. The role of the Bonneville Power Administration in the Pacific Northwest power supply system, including its participation in a hydro-thermal power program, 5:33599 (DOE/EIS—0066)
PACIFIC OCEAN/AIR-WATER INTERACTIONS
Further study of the variability in the frequency of typhoon formation over the West Pacific ocean, 5:34112 (COO—1340-75)
PALLADIUM/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
PALLADIUM/LIGHT TRANSMISSION
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878

PALLADIUM/MAGNETIC SUSCEPTIBILITY
Observation of a strongly enhanced magnetic susceptibility of Pd in Au-Pd-Au sandwiches, 5:33881
PALLADIUM/SPECTRAL REFLECTANCE
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
PARABOLIC COLLECTORS
See also PARABOLIC DISH COLLECTORS
PARABOLIC TROUGH COLLECTORS
PARABOLIC COLLECTORS/DESIGN
Parabolic solar reflector for accurate and economic producibility, 5:33531
Stationary concentrator for industry, 5:33525
PARABOLIC COLLECTORS/PERFORMANCE
Parabolic solar reflector for accurate and economic producibility, 5:33531
PARABOLIC DISH COLLECTORS/MARKETING RESEARCH
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
PARABOLIC DISH COLLECTORS/RESEARCH PROGRAMS
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
PARABOLIC POINT COLLECTORS
See PARABOLIC DISH COLLECTORS
PARABOLIC REFLECTORS
See also COMPOUND PARABOLIC CONCENTRATORS
PARABOLIC REFLECTORS/OPTICS
Analysis of a Cassegrain solar furnace, 5:33511
PARABOLIC TROUGH COLLECTORS/DESIGN
High temperature collector systems and report on integrated systems for cooling, desalination, and power generation, 5:33523
PARABOLIC TROUGH COLLECTORS/USES
High temperature collector systems and report on integrated systems for cooling, desalination, and power generation, 5:33523
PARAFFINS
See ALKANES
PARAMETRIC AMPLIFIERS/JOSEPHSON JUNCTIONS
Microwave parametric amplifiers using externally pumped Josephson junctions, 5:33988
Phase instability noise in Josephson junctions, 5:33989
PARAMETRIC INSTABILITIES/DISPERSION RELATIONS
Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma, 5:34409
PARAMETRIC INSTABILITIES/ICR HEATING
Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma, 5:34409
PARAMETRIC INSTABILITIES/ION PLASMA WAVES
Parametric decay into ion cyclotron waves and drift waves in multi-ion species plasma, 5:34409
PARAMETRIC INSTABILITIES/NONLINEAR PROBLEMS
Parametric excitation of ion quasi-mode by the pump near the ion cyclotron frequency, 5:34410
PARTICLE INTERACTIONS
See also PHOTON-PHOTON INTERACTIONS
QUARK-ANTIQUARK INTERACTIONS
PARTICLE INTERACTIONS/SCATTERING
Scattering in the quasiperiodic and stochastic regimes, 5:34308 (CONF-800829—7)
PARTICLE SIZE/DISTRIBUTION FUNCTIONS
Polydisperse-particle-size-distribution function determined from intensity profile on angularly scattered light: author's reply to comment, 5:34385
PASSIVE SOLAR COOLING SYSTEMS/DESIGN
Passive solar design handbook. Volume one of two volumes. Passive solar design concepts, 5:33461 (DOE/CS—0127/1)
PASSIVE SOLAR COOLING SYSTEMS/RESEARCH PROGRAMS
Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
PASSIVE SOLAR HEATING SYSTEMS
See also TROMBE WALLS
WATER WALLS
Natural convective heat transfer through an aperture in passive solar heated buildings, 5:33480 (LA-UR—80-2328)
PASSIVE SOLAR HEATING SYSTEMS/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
PASSIVE SOLAR HEATING SYSTEMS/DESIGN
Passive solar design handbook. Volume one of two volumes. Passive solar design concepts, 5:33461 (DOE/CS—0127/1)
Passive solar handbook, 5:33483 (NP—24992)
Passive solar house designs for New Mexico climates. Final report, July 1, 1978-January 31, 1980. Part 1: design manual, 5:33482 (NMEI—22)
Preliminary designs: passive solar manufactured housing. Technical status report, 5:33463 (DOE/CS/30377—1)
PASSIVE SOLAR HEATING SYSTEMS/LATENT HEAT STORAGE
Study of two passive solar systems containing phase change materials for thermal storage, 5:33475 (LA-UR—80-1669)
PASSIVE SOLAR HEATING SYSTEMS/MANUALS
Passive solar handbook, 5:33483 (NP—24992)
PASSIVE SOLAR HEATING SYSTEMS/MONITORING
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
PASSIVE SOLAR HEATING SYSTEMS/PERFORMANCE
Attached sunspace heating performance estimates, 5:33477 (LA-UR—80-2236)
Study of two passive solar systems containing phase change materials for thermal storage, 5:33475 (LA-UR—80-1669)
PASSIVE SOLAR HEATING SYSTEMS/RESEARCH PROGRAMS
Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 10, 19 December 1979-19 March 1980, 5:33466 (DOE/EG/34135—10)
PDX DEVICES/PLASMA DIAGNOSTICS
In-situ impurity measurements in PDX Edge plasma, 5:34398 (PPPL—1688)
PDX DEVICES/PLASMA SHEATH
In-situ impurity measurements in PDX Edge plasma, 5:34398 (PPPL—1688)
PEANUT OIL/CHEMICAL COMPOSITION
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
PEANUT OIL/PHYSICAL PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
PEANUT OIL/THERMODYNAMIC PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
PEAT/RESOURCE POTENTIAL
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
PENETRATORS/COMPUTER-AIDED DESIGN
Computer design of a high explosive velocity augmented kinetic energy penetrator (Using DYNA 2D computer code), 5:33957 (UCRL—83559)
PENNSYLVANIA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
PEOPLES REPUBLIC OF CHINA
See CHINA
PEROVSKITES/CATALYTIC EFFECTS
Hydrocarbon cracking catalyst (Patent), 5:33255
PERSONNEL/DECONTAMINATION
Decontamination and decorporation: the clinical experience, 5:33340 (DPSPU—79-30-19)
PERSONNEL/DIRECTORIES
Directory of North Carolina energy-resource personnel, 5:33816 (NCEI—0017)
PERSONNEL/MORTALITY
Continuing study of mortality in Hanford workers, 5:34187 (PNL-SA—8106)
Mortality of Hanford radiation workers, 5:34188 (PNL-SA—8110)
PERSONNEL MONITORING/MEASURING INSTRUMENTS
Use of a fiber-optics skin contamination monitor in the workplace, 5:33240 (CONF-800814—13)
PERTECHNETATES/SORPTION
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
PETROLEUM
See also OIL WELLS
RESIDUAL PETROLEUM
SHALE OIL
PETROLEUM/ALLOCATIONS
Environmental assessment: allocation of petroleum feedstock, Columbia LNG Corporation, Green Springs SNG Plant, Green Springs, Seneca County, Ohio, 5:33269 (DOE/EA—0061)
PETROLEUM/CATALYTIC CRACKING
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253
Fluid cracking catalyst process using a zeolite dispersed in a magnesia-alumina-aluminum phosphate matrix (Patent), 5:33260
PETROLEUM/DESULFURIZATION
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253

Sorbent regeneration in a process for removing sulfur-containing impurities from mineral oils (Patent), 5:33257
PETROLEUM/ENERGY SUPPLIES
International energy indicators, 5:33663 (DOE/IA—0010/2)
PETROLEUM/ENHANCED RECOVERY
FY 80 heavy oil program. Second quarterly report, April 1980, 5:33248 (SAND—80-1019)
PETROLEUM/GLOBAL ASPECTS
International energy indicators, 5:33663 (DOE/IA—0010/2)
PETROLEUM/HYDROCRACKING
Development of a simulated catalyst aging technique, 5:33264
PETROLEUM/HYDROGENATION
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253
PETROLEUM/POUR POINT
Low pour point crude oil compositions (Patent), 5:33275
Residual fuel compositions with low pour points (Patent), 5:33276
PETROLEUM/PRICES
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)
PETROLEUM/PRODUCTION
Annual report to Congress, 1979. Volume 3. Projections (For periods 1980-1981, 1985-1995, and 2000-2020; includes glossary), 5:33696 (DOE/EIA—0173(79)3)
Energy data report: world crude oil production annual 1978, 5:33265 (DOE/EIA—0117/78)
International energy indicators, 5:33663 (DOE/IA—0010/2)
PETROLEUM/REFINING
Process for aromatics extraction from a 300 to 430°F boiling range naphtha (Patent), 5:33256
PETROLEUM/REGULATIONS
Oil ang gas: general rules and regulations, 5:33705
PETROLEUM/STATISTICS
Mineral oil statistics 1979 for the Federal Republic of Germany with comparative figures for January/December 1978, 5:33268 (NP—24979)
PETROLEUM/TRADE
International energy indicators, 5:33663 (DOE/IA—0010/2)
PETROLEUM/TRANSPORT
Low pour point crude oil compositions (Patent), 5:33275
Residual fuel compositions with low pour points (Patent), 5:33276
PETROLEUM DEPOSITS
See also OIL FIELDS
PETROLEUM DEPOSITS/CHEMICAL COMPOSITION
Characteristics of evolution of petroleum in Huanghua Depression, 5:33242 (JPRS—75887)
PETROLEUM DEPOSITS/LEASING
Bidding and production profiles for the various outer continental shelf leasing methodologies, 1954 to 1978, 5:33267 (LA—8497-MS)
PETROLEUM DEPOSITS/PHYSICAL PROPERTIES
Characteristics of evolution of petroleum in Huanghua Depression, 5:33242 (JPRS—75887)
PETROLEUM GEOLOGY
Characteristics of evolution of petroleum in Huanghua Depression, 5:33242 (JPRS—75887)
PETROLEUM GEOLOGY/LEADING ABSTRACT
China report: science and technology, No. 40, 5:33557 (JPRS—75887)
PETROLEUM INDUSTRY
See also MINERAL INDUSTRY
Annual report, 1979 (In German), 5:33707 (NP—25049)
PETROLEUM INDUSTRY/LEGISLATION
General order prescribing rules and regulations governing the conservation of oil and gas in Alabama and oil and gas laws of Alabama with Oil and Gas Board forms, 5:33273
PETROLEUM INDUSTRY/REGULATIONS
General order prescribing rules and regulations governing the conservation of oil and gas in Alabama and oil and gas laws of Alabama with Oil and Gas Board forms, 5:33273
PETROLEUM REFINERIES/COMPETITION
Competitive economics of United States and foreign refining, 5:33266 (DOE/PE/70076—T1)
PETROLEUM REFINERIES/LEGAL ASPECTS
Refinery siting workbook: appendices A and B, 5:33225 (DOE/RA/33001—01(Vol.1))
PETROLEUM REFINERIES/POLLUTION LAWS
Refinery siting workbook: appendices C to O, 5:33274 (DOE/RA/33001—01(Vol.2))
PETROLEUM REFINERIES/SITE SELECTION
Refinery siting workbook: appendices A and B, 5:33225 (DOE/RA/33001—01(Vol.1))
Refinery siting workbook: appendices C to O, 5:33274 (DOE/RA/33001—01(Vol.2))
PETROLEUM REFINERIES/SOCIO-ECONOMIC FACTORS
Refinery siting workbook: appendices A and B, 5:33225 (DOE/RA/33001—01(Vol.1))
PETROLEUM REFINERIES/SOLAR PROCESS HEAT
Solar industrial retrofit system for the Provident Energy Company refinery. Appendices to final report, September 28, 1979 to July 15, 1980, 5:33493 (DOE/SF/10606—1(App.))
Solar industrial retrofit system for the Provident Energy Company refinery. Sections 2-8. Final report, September 28, 1979 to July 15, 1980, 5:33492 (DOE/SF/10606—1/2)
Solar industrial retrofit system for the Provident Energy Company refinery. Section 1: executive summary. Final report, September 28, 1979-July 15, 1980, 5:33491 (DOE/SF/10606—1/1)
PETT
See POSITRON COMPUTED TOMOGRAPHY
PHAGES
See BACTERIOPHAGES
PHARMACEUTICALS
See DRUGS
PHASE CHANGE MATERIALS/BIBLIOGRAPHIES
Phase change/heat storage materials data compilation. Final technical report, August 1978-January 1979, 5:33640 (AD-A—076414)
PHASE CHANGE MATERIALS/THERMODYNAMIC PROPERTIES
Development of intermediate temperature thermal storage systems. Final technical report, April 1, 1978-May 31, 1979, 5:33641 (DOE/CS/35760—T1)
PHOSPHATE GLASS/BIREFRINGENCE
Piezooptic coefficients of four neodymium-doped laser glasses, 5:33918
PHOSPHATE GLASS/PHOTOELASTICITY
Piezooptic coefficients of four neodymium-doped laser glasses, 5:33918
PHOSPHINES/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
PHOSPHORUS/TOXICITY
Toxicology of phosphorus, thiourea, and other chemicals, 5:34211 (BNL—51118)
PHOTOCHEMICAL REACTIONS
See also PHOTOSYNTHESIS
PHOTOCHEMICAL REACTIONS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
PHOTOELECTROCHEMICAL CELLS/ELECTRODES
Photoelectrochemistry with p-Si electrodes: Effects of inversion, 5:33936
PHOTON-ATOM COLLISIONS/ENERGY TRANSFER
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
PHOTON-MOLECULE COLLISIONS/ENERGY TRANSFER
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
PHOTON-PHOTON INTERACTIONS/QUANTUM CHROMODYNAMICS
Two-photon collisions and QCD, 5:34288 (SLAC-PUB—2503)
PHOTONS/MICRODOSIMETRY
Microdosimetric measurements for photons in a water phantom, 5:34367 (BNL—28157)
PHOTOSYNTHESIS/SEASONAL VARIATIONS
Seasonal changes in within-canopy allocation of ^{14}C-photosynthate by white oak, 5:34179
PHOTOSYNTHETIC BACTERIA/CELL CULTURES
Collection, purification, and culture of cyanobacteria, 5:34156 (BNL—28136)
PHOTOVOLTAIC CELLS
See also SOLAR CELLS
PHOTOVOLTAIC CELLS/ENVIRONMENTAL IMPACTS
Potential effects of PV-related compounds on food webs, 5:34196 (BNL—51118)
PHOTOVOLTAIC CELLS/HEALTH HAZARDS
Environmental controls at Motorola, 5:33396 (BNL—51118)
Health effects of photovoltaic technology, 5:33387 (BNL—51118)
PHOTOVOLTAIC CELLS/MEETINGS
Health effects of photovoltaic technology, 5:33387 (BNL—51118)
PHOTOVOLTAIC CELLS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
PHOTOVOLTAIC CONVERSION/SOLID STATE PHYSICS
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
PHOTOVOLTAIC POWER PLANTS
See also SOLAR CELL ARRAYS
PHOTOVOLTAIC POWER PLANTS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)

Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
PHOTOVOLTAIC POWER SUPPLIES/DC TO DC CONVERTERS
The application of dc-dc energy conversion in a solar energy system. Final report, 5:33441 (AD-A—077112)
PHOTOVOLTAIC POWER SUPPLIES/DEMONSTRATION PROGRAMS
Solar photovoltaic systems for residences in the Northeast, 5:33445 (DOE/ET/20279—100)
Systems development activities and photovoltaic concentrator technology, 5:33442 (BNL—51118)
PHOTOVOLTAIC POWER SUPPLIES/ELECTRIC CABLES
Handbook for photovoltaic cabling, 5:33444 (COO—4094-90)
PHOTOVOLTAIC POWER SUPPLIES/FLYWHEEL ENERGY STORAGE
Dynamic analysis of a magnetically suspended energy storage wheel, 5:33637 (DOE/ET/20279—102)
Performance testing and economic analysis of a photovoltaic flywheel energy storage and conversion system, 5:33636 (COO—4094-91)
PHOTOVOLTAIC POWER SUPPLIES/NATIONAL PROGRAM PLANS
Overview of the national photovoltaic program, 5:33393 (BNL—51118)
PHOTOVOLTAIC POWER SUPPLIES/TECHNOLOGY ASSESSMENT
Future of photovoltaic energy conversion in developing countries, 5:33446 (SERI/TP—611-407)
PHYSICAL PROTECTION DEVICES
Design concepts to enhance nuclear power plant protection, 5:33612 (SAND—80-1428C)
PHYSICAL PROTECTION DEVICES/CONTROL EQUIPMENT
Microcomputer closed circuit television controller, 5:34056 (SAND—79-0688)
PHYTOCHROMES/GENES
Organization of the R chromosome region in maize, 5:34170 (COO—1300-45)
PIES/ALGORITHMS
Hogan's PIES example and Lemke's algorithm. Technical summary report, 5:34441 (AD-A—077103)
PILOT PLANTS
See also DEMONSTRATION PLANTS
PILOT PLANTS/WATER TREATMENT
Biological treatment of Grand Forks Energy Technology Center slagging fixed-bed coal gasification process wastewater. Eleventh quarterly report, March 1979, 5:33220 (FE—2496-42)
PINES/HERBICIDES
Paraquat and pine trees in east Tennessee, 5:33438
PINS (FUEL)
See FUEL PINS
PION MINUS REACTIONS/MULTIPLE PRODUCTION
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
PION MINUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
PION MINUS-PROTON INTERACTIONS/EXCLUSIVE INTERACTIONS
Search for narrow states produced in the reaction $\pi^- p \rightarrow n + \gamma$'s at 13 GeV/c, 5:34284 (BNL—28057)
PION PLUS REACTIONS/CHARGE-EXCHANGE REACTIONS
Isospin quintets in the 1p and s-d shells, 5:34318
PION PLUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
PION REACTIONS/COHERENT PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
PION REACTIONS/LECTURES
Self-consistent theory of hadron-nucleus scattering. Application to pion physics, 5:34354 (LA-UR—80-2496)
PION REACTIONS/MULTIPLE PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
PION REACTIONS/PARTICLE PRODUCTION
Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957)
PIONS/STRUCTURE FUNCTIONS
Determination of the pion and kaon structure functions, 5:34296
PIPE JOINTS/BELLOWS
Investigation on the reliability of expansion joint for piping with probabilistic method (LMFBR), 5:33624 (JAPFNR—506)
PIPELINE QUALITY GAS
See HIGH BTU GAS
PIPELINES/CONSTRUCTION
Pipe-laying machine for oil pipelines, conduits and the like (Patent), 5:34024
PIPELINES/FUEL SUBSTITUTION
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
PIPELINES/FUELS
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
PIPELINES/POSITIONING
Methods and apparatus for anchoring offshore pipeline (Patent), 5:34026
PIPES/CLOSURES
Retrievable plug for offshore platforms (Patent), 5:34025
PIPES/DESIGN
Report of ad hoc OTEC cold water pipe committee, 5:33458 (DOE/ET/21002—2)
PLANNED COMMUNITIES/SOLAR ACCESS
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
PLANNED COMMUNITIES/ZONING
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
PLANTS
See also ALGAE
EUPHORBIA
GRASS
LEGUMINOSAE
TREES
WATER HYACINTHS
PLANTS/CULTIVATION TECHNIQUES
Cattails as an energy source. Final report, 5:33440
PLANTS/HARVESTING
Potential of cattails as an energy source. Final report, 5:33434
PLANTS/PHOTOSYNTHESIS
Picosecond electron transfer in diporphyrin models of Photosystem II of green plants, 5:34167 (BNL—28030)
PLANTS/PRODUCTIVITY
Cattails as an energy source. Final report, 5:33440
Nitrogen cycling: water use efficiency interactions in semi-arid ecosystems in relation to management of tree legumes (Prosopis), 5:34180 (CONF-8004108—1)
Potential of cattails as an energy source. Final report, 5:33434
PLANTS (INDUSTRIAL)
See INDUSTRIAL PLANTS
PLANTS (PILOT)
See PILOT PLANTS
PLANTS (POWER)
See POWER PLANTS
PLASMA
See also BEAM-PLASMA SYSTEMS
PLASMA/BREMSSTRAHLUNG
High-energy bremsstrahlung in an intense laser field, 5:34404
PLASMA/DIELECTRIC PROPERTIES
Dielectric response in guiding center plasma, 5:34406
PLASMA/PHOTON-ELECTRON INTERACTIONS
High-energy bremsstrahlung in an intense laser field, 5:34404
PLASMA/RELAXATION
Incomplete relaxation and finite beta plasmas, 5:34402 (LA-UR—80-2043)
PLASMA/TRANSPORT THEORY
Alternating dimension plasma transport in three dimensions, 5:34400 (COO—3077-164)
Anomalous transport from plasma waves, 5:34407
PLASMA/TURBULENCE
Dielectric response in guiding center plasma, 5:34406
PLASMA CONFINEMENT
See also INERTIAL CONFINEMENT
PLASMA CONFINEMENT/EQUILIBRIUM
Bifurcation of sharp boundary $\beta = 1$ multipole equilibria, 5:34396
PLASMA CONFINEMENT/MULTIPOLAR CONFIGURATIONS
Bifurcation of sharp boundary $\beta = 1$ multipole equilibria, 5:34396
PLASMA DIAGNOSTICS/ION BEAMS
Ion beam probe diagnostic system. Technical progress report, 1 January 1979-30 June 1980. RPDL report No. 80-17, 5:34397 (DOE/ET/53004—1)
PLASMA DIAGNOSTICS/SPECTROSCOPY
In-situ impurity measurements in PDX Edge plasma, 5:34398 (PPPL—1688)
PLASMA EXPANSION/ADIABATIC PROCESSES
Power-driven and adiabatic expansions into vacuum, 5:34428

PLASMA EXPANSION/HYDRODYNAMICS
Power-driven and adiabatic expansions into vacuum, 5:34428
PLASMA HEATING
See also HIGH-FREQUENCY HEATING
PLASMA HEATING/REVIEWS
Methods of driving current by heating a toroidal plasma, 5:34395 (PPPL—1692)
PLASMA WAVES/PLASMA INSTABILITY
Anomalous transport from plasma waves, 5:34407
PLASTER OF PARIS
See GYPSUM CEMENTS
PLASTICS
See also ARAMIDS
POLYETHYLENES
PLASTICS/LIGHT SCATTERING
Specularity measurements for solar materials, 5:33538
PLASTICS/OPTICAL PROPERTIES
Specularity measurements for solar materials, 5:33538
PLATES
(Thicker than SHEETS or FOILS.)
PLATES/DEFECTS
Stress concentration factors due to flaws near the edge of a plate under tension, 5:33948 (IS-T—928)
PLATES/STRESS INTENSITY FACTORS
Stress concentration factors due to flaws near the edge of a plate under tension, 5:33948 (IS-T—928)
PLATINUM/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
PLATINUM/ELECTRONIC STRUCTURE
Angle-resolved photoemission determination of A-line valence bands in Pt and Au using synchrotron radiation, 5:33877
PLATINUM/LIGHT TRANSMISSION
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
PLATINUM/PHOTOELECTRON SPECTROSCOPY
Angle-resolved photoemission determination of A-line valence bands in Pt and Au using synchrotron radiation, 5:33877
PLATINUM/SPECTRAL REFLECTANCE
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
PLUGS
See CLOSURES
PLUMES/CHEMICAL REACTION KINETICS
Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
PLUMES/ENVIRONMENTAL TRANSPORT
Drift deposition from mechanical draft cooling towers, 5:33589 (PNL-SA—7422)
Tracking of smokestack and cooling tower plumes using wind measurements at different levels, 5:34128 (ORNL/TM—7417)
PLUMES/MATHEMATICAL MODELS
Dispersion modeling of a plume in the tar sands area. Syncrude environmental research report, 1980-1981, 5:34127 (NP—25069)
PLUMES/MONITORING
Plume conversion rates in the SURE Region. Final report, 5:34121 (EPRI-EA—1498(Vol.1))
PLUMES/SPATIAL DISTRIBUTION
Dispersion modeling of a plume in the tar sands area. Syncrude environmental research report, 1980-1981, 5:34127 (NP—25069)
PLUTONIUM/SORPTION
Radionuclide sorption and migration studies of getters for backfill barriers, 5:33332 (SAND—79-1110)
PLUTONIUM/TRANSMUTATION
Transmutation of radwaste using accelerators, 5:33321 (RHO-SA—174)
PLUTONIUM 238/RADIOISOTOPE HEAT SOURCES
General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980, 5:33349 (LA—8454-PR)
PLUTONIUM 238/RADIONUCLIDE MIGRATION
Adsorption and diffusion of plutonium in soil, 5:34152 (DOE/EV/04700—T1)
PLUTONIUM 238/SAFETY
General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980, 5:33349 (LA—8454-PR)
PLUTONIUM 239/RADIONUCLIDE MIGRATION
Adsorption and diffusion of plutonium in soil, 5:34152 (DOE/EV/04700—T1)
PLUTONIUM 241/ENERGY LEVELS
Gamma rays following alpha decay of ^{245}Cm and the level structure of ^{241}Pu, 5:34344
PLUTONIUM 241/FISSION YIELD
Fast reactor fission yields for ^{241}Pu and relative fission product isotopic data for ^{239}Pu irradiated in Row-4 of EBR-II, 5:33617 (ENICO—1046)
PLUTONIUM CARBIDES/SPECIFIC HEAT
Low temperature specific heats of three plutonium carbides, 5:33905
PLUTONIUM COMPOUNDS/REDOX REACTIONS
Redox reactions involving chromium, plutonium, and manganese in soils, 5:34150 (DOE/DP/04515—1)
PLUTONIUM COMPOUNDS/VALENCE
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
PLUTONIUM DIOXIDE/PRODUCTION
Mixed oxide conversion facility alternative conceptual designs (Coprecipitation-direct calcination (COPRECAL)), 5:33306 (AGNS—35900-CONF-71)
PLUTONIUM OXIDES/BIODEGRADATION
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
PLUTONIUM OXIDES/DISSOLUTION
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
PNA
See POLYCYCLIC AROMATIC HYDROCARBONS
PNEUMATIC TRANSPORT/MONITORING
Evaluation of a Coriolis mass flow meter for pulverized coal flows, 5:33745 (DOE/ET/10815—T2)
POISEUILLE FLOW
See LAMINAR FLOW
POLARIMETERS/PERFORMANCE
Polarimeter for protons between 300 and 800 MeV, 5:34095 (LA-UR—80-1943)
POLARIZED BEAMS/ION SOURCES
Operating experience and cesium recycling on the LASL polarized triton source, 5:34076 (LA-UR—80-1905)
POLLUTION CONTROL
See also AIR POLLUTION CONTROL
POLLUTION CONTROL/ENVIRONMENTAL IMPACTS
Energy policy study. Volume 12. Governmental actions affecting the environment and their effects on energy markets, 5:34140 (DOE/EIA—0201/12)
POLLUTION CONTROL/TECHNOLOGY ASSESSMENT
Environmental control technologies for a northern California coal-fired power plant, 5:33597 (P—300-80-002)
POLLUTION SOURCES/EMISSION
Annual emissions and air-quality impacts of an urban area district-heating system: Boston case study, 5:33801 (ANL/CNSV-TM—36)
POLOIDAL DIVERTORS
Poloidal divertor experiment with applied E vector x B vector/B^2 drift, 5:34434 (DOE/ET/53051—5)
Properties of diverted plasmas with magnetically expanded flux surfaces, 5:34399 (GA-A—15963)
Stability and heating of a poloidal divertor tokamak, 5:34435 (DOE/ET/53051—6)
POLORIDAL DIVERTOR EXPERIMENT
See PDX DEVICES
POLYCYCLIC AROMATIC HYDROCARBONS/MUTAGEN SCREENING
Low Btu gasifier emissions toxicology program. Status report October 1979, 5:34198 (LMF—75)
POLYETHYLENES/DIELECTRIC PROPERTIES
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
POLYETHYLENES/PERFORMANCE TESTING
Impregnation of solid dielectric cable insulation. Final report, 5:33603 (EPRI-EL—1435)
POLYMER FLOODING
See MICROEMULSION FLOODING
POLYMERS
See also PLASTICS
POLYMERS/FLUID MECHANICS
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)
POLYMERS/MATHEMATICAL MODELS
Segment density functions of polymer chains confined by absorbing or reflecting barriers, 5:34263 (DOE/ER/01198—T1)
POLYMERS/MECHANICAL PROPERTIES
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)

POLYMERS/MOLECULAR STRUCTURE
Segment density functions of polymer chains confined by absorbing or reflecting barriers, 5:34263 (DOE/ER/01198—T1)
POLYMERS/RESEARCH PROGRAMS
Polymers in solar technologies: an R and D strategy, 5:33521 (SERI/TR—334-601)
POLYMERS/VISCOSITY
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)
POLYNUCLEAR HYDROCARBONS
See CONDENSED AROMATICS
POMERANCHUK PARTICLES/DUALITY
Regge slopes in dual topological expansion, 5:34286
POMERANCHUK PARTICLES/REGGE TRAJECTORIES
Regge slopes in dual topological expansion, 5:34286
POMERONS
See POMERANCHUK PARTICLES
PONDS
See also COOLING PONDS
PONDS/MAPPING
Locations and areas of ponds and Carolina Bays at the Savannah River Plant, 5:34154 (DP—1525)
PONDS (COOLING)
See COOLING PONDS
POOR PEOPLE
See LOW INCOME GROUPS
POPULATION DENSITY
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
POROSITY/FORECASTING
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
POROUS MATERIALS/CONVECTION
Steady thermal convection from a concentrated source in a porous medium, 5:34036
PORPHYRINS
See also CHLOROPHYLL
HEMOGLOBIN
PORPHYRINS/MOLECULAR STRUCTURE
Chemical Sciences Division, 5:33922 (BNL—50973)
PORPHYRINS/PHOTOCHEMICAL REACTIONS
Chemical Sciences Division, 5:33922 (BNL—50973)
POSITIVE IONS
See CATIONS
POSITRON COMPUTED TOMOGRAPHY
Positron computed tomography: current state, clinical results and future trends, 5:34176 (UCLA—12-1258)
POSITRONS/USES
Positive muon and the positron as probes of defects, 5:34249 (BNL—28196)
POTASSIUM/CATALYTIC EFFECTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
POTASSIUM/CRYSTAL STRUCTURE
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
POTASSIUM/F CENTERS
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
POTASSIUM/MUONIC ATOMS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
POTASSIUM/PHYSICAL PROPERTIES
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
POTASSIUM 39/ENERGY LEVELS
Comparison of the single-proton pickup reactions $^{40}Ca(^{11}B,^{12}C)^{39}K$and $^{40}Ca(^{13}C,^{14}N)^{39}K$at low and high bombarding energies, 5:34326
POTASSIUM BROMIDES/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
POTASSIUM CHLORIDES/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
POTASSIUM SULFATES/VIBRATIONAL STATES
Raman spectroscopy of molten mixtures of lithium and potassium sulfate, 5:33929 (CONF-800808—6)
POWER DEMAND/DATA ACQUISITION
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume X. Metering-sampling methodology and procedures for metering data collection , 5:33723 (P—300-80-017)
POWER DEMAND/FORECASTING
Development of a commercial-sector data base and forecasting model for electricity usage and demand. Volume I. Preliminary model specification, 5:33713 (P—300-80-007)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume II. Project data requirements and data-management procedures , 5:33714 (P—300-80-008)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume III. Preliminary survey, sampling methodology, 5:33715 (P—300-80-009)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-A. Detailed model specification, engineering aspects, 5:33716 (P—300-80-010)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume IV-B. Detailed model specification, economic, and behavioral aspects, 5:33717 (P—300-80-011)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume V. Review of secondary data, 5:33718 (P—300-80-012)
Development of a data base and forecasting model for commercial-sector electricity usage and demand. Volume XI. Model-parameter specification , 5:33724 (P—300-80-018)
Forecasting higher order statistical moments and probability densities for power system loads by the method of time series, 5:33701 (PCTR—92-80)
POWER GENERATION
See also CO-GENERATION
POWER GENERATION/CAPITALIZED COST
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
POWER GENERATION/ENVIRONMENTAL IMPACTS
Environmental implications of electric-utility supply plans, 1978-2000, 5:33738 (P—300-80-005)
POWER GENERATION/FUEL SUBSTITUTION
Assessment of alcohol fuels for stationary gas turbines: technology of utilization and prospects for matching future energy demand, 5:33846 (CONF-790520—)
POWER GENERATION/OPERATING COST
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
POWER GENERATION/REGIONAL ANALYSIS
Monthly comparisons of peak demands and energy for load, 1974 to 1978, 5:33731 (DOE/EIA—0010/3)
POWER GENERATION/RELIABILITY
Reliability problems in power-generation systems, 5:33736 (LA-UR—80-2354)
POWER GENERATION/TECHNOLOGY ASSESSMENT
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
POWER PLANTS
See also FUEL CELL POWER PLANTS
HYDROELECTRIC POWER PLANTS
SOLAR POWER PLANTS
THERMAL POWER PLANTS
WIND POWER PLANTS
POWER PLANTS/CAPACITY
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
POWER PLANTS/FUEL SUPPLIES
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
POWER PLANTS/POWER GENERATION
Preliminary power production, fuel consumption, and installed capacity data for 1978, 5:33732 (DOE/EIA—0049/78)
Preliminary power production, fuel consumption, and installed capacity data for 1979, 5:33733 (DOE/EIA—0049(79))
POWER POOLS
See INTERCONNECTED POWER SYSTEMS
POWER SYSTEMS
See also INTERCONNECTED POWER SYSTEMS
POWER SYSTEMS/CONTROL SYSTEMS
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume I. Summary final report, 5:33606 (JPL-PUBL—80-48(Vol.1))
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume II. Supporting data and analyses, 5:33607 (JPL-PUBL—80-48(Vol.2))

POWER SYSTEMS/LOAD MANAGEMENT
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume I. Summary final report, 5:33606 (JPL-PUBL—80-48(Vol.1))
Study of a Space Communication System for the control and monitoring of the Electric Distribution System..Volume II. Supporting data and analyses, 5:33607 (JPL-PUBL—80-48(Vol.2))
POWER SYSTEMS/MONITORING
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume I. Summary final report, 5:33606 (JPL-PUBL—80-48(Vol.1))
Study of a Space Communication System for the control and monitoring of the Electric Distribution System. Volume II. Supporting data and analyses, 5:33607 (JPL-PUBL—80-48(Vol.2))
POWER SYSTEMS/POWER DEMAND
Forecasting higher order statistical moments and probability densities for power system loads by the method of time series, 5:33701 (PCTR—92-80)
POWER TRANSMISSION/CONTROL SYSTEMS
Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses, 5:33740 (JPL-PUB—80-48(Vol.2))
POWER TRANSMISSION TOWERS/PRESERVATION
Controlling biological deterioration of wood with volatile chemicals. Final report, 5:33604 (EPRI-EL—1480)
POWER TRANSMISSION TOWERS/SUPPORT PILLARS
Controlling biological deterioration of wood with volatile chemicals. Final report, 5:33604 (EPRI-EL—1480)
PRASEODYMIUM ALLOYS/SUPERCONDUCTIVITY
Experimental studies in solid state and low temperature physics. Final report for 1966-1980, 5:34378 (DOE/ER/01569—147)
PRECIPITATIONS (ATMOSPHERIC)
See ATMOSPHERIC PRECIPITATIONS
PRESSURE VESSELS/ACOUSTIC EMISSION TESTING
Acoustic emission for quality control of kevlar 49 filament-wound composites, 5:33911 (UCRL—83783)
PRESSURIZED WATER REACTORS
See PWR TYPE REACTORS
PRIMARY COOLANT CIRCUITS/PIPE JOINTS
Investigation on the reliability of expansion joint for piping with probabilistic method (LMFBR), 5:33624 (JAPFNR—506)
PRIMARY COOLANT CIRCUITS/PRESSURE GRADIENTS
Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow (PWR; BWR), 5:33611 (DOE/ET/34209—T1)
PRIMARY COOLANT CIRCUITS/TURBULENT FLOW
Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow (PWR; BWR), 5:33611 (DOE/ET/34209—T1)
PRIMARY COOLANT CIRCUITS/VALVES
Development of bellows for sodium valve in Japan (LMFBR), 5:33625 (JAPFNR—507)
PRIMARY COSMIC RADIATION/CHEMICAL COMPOSITION
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
PRIMARY COSMIC RADIATION/ENERGY SPECTRA
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
PRIMARY COSMIC RADIATION/LECTURES
Cosmic ray data on high-energy hadron-nucleus and nucleus-nucleus collisions, 5:34282 (LBL—8957)
PRINTED CIRCUITS/FABRICATION
Cure cycle evaluation for multilayer printed wiring boards, 5:34050 (BDX—613-2392)
Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
Plasma etchback of multilayer printed wiring boards, 5:34051 (BDX—613-2458)
PRINTED CIRCUITS/QUALITY ASSURANCE
Improved techniques to monitor thin film characteristics for reliable hybrid microcircuit fabrication, 5:34053 (BDX—613-2478)
PROBES
See also MUON PROBES
PROBES/HALL EFFECT
Pico amp measurement circuit with high system isolation, 5:34100 (SAND—80-8222)
PROBES/MODIFICATIONS
Pico amp measurement circuit with high system isolation, 5:34100 (SAND—80-8222)
PROCUREMENT
Business strategy groups lessons learned, 5:34439 (DOE/PR—0041)
PRODUCTION (ISOTOPE)
See ISOTOPE PRODUCTION
PRODUCTION REACTORS
(For the production of fissile materials only; see also IRRADIATION REACTORS.)
PRODUCTION REACTORS/CHEMICAL EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
PRODUCTION REACTORS/RADIOACTIVE EFFLUENTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
PROFESSIONS
See OCCUPATIONS
PROGRAMMING LANGUAGES
See also FORTRAN
DOE-2. Part 1. Reference manual. Version 2.1 (Building Description Language), 5:33762 (LA—7689-M(Ver.2.1))
PROJECT INDEPENDENCE EVALUATION SYSTEM
See PIES
PROMETHAZINE
See AMINES
PROMETHIUM 149/ENERGY LEVELS
Single-proton states in ^{149}Pm, 5:34334
PROMPT NEUTRONS/MULTIPLICITY
Fission neutron multiplicity for /sup 242m/Am (0 to 30 MeV), 5:34348 (UCID—18577)
PROPANE/TRANSPORT
Assessment of the risk of transporting propane by truck and train, 5:34218 (PNL-SA—8202)
PROPANOLS/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
PROPANOLS/PHYSICAL PROPERTIES
Physical properties of gasoline/alcohol automotive fuels, 5:33359 (CONF-790520—)
PROPANONE
See ACETONE
PROPORTIONAL COUNTERS/DATA ACQUISITION SYSTEMS
Tissue equivalent proportional counter neutron monitor, 5:34088 (HEDL-SA—2041)
PROPORTIONAL COUNTERS/MONOCHROMATORS
New small-angle neutron scattering (SANS) instrument at ORNL using a position-sensitive area detector, 5:34090
PROPORTIONAL COUNTERS/TESTING
Proposal for a new neutrino detector at Fermilab to study the weak neutral current. Annual technical progress report, 5:34081 (DOE/ER/05023—1)
PROTON BEAMS/POLARIMETERS
Polarimeter for protons between 300 and 800 MeV, 5:34095 (LA-UR—80-1943)
PROTON REACTIONS/CAPTURE
Measurement of $p+d \rightarrow {}^3He+\gamma$ and comparison with the inverse reaction, 5:34315
PROTON REACTIONS/CHARGE-EXCHANGE REACTIONS
Measurements of ^{88}Sr(p,n) to the ground state and low-lying excited states of ^{88}Y (5.75 to 11 MeV), 5:34329 (UCID—18577)
Measurement of K/sub NN/, K/sub LL/ in p vector d → n vector X and p vector ^{9}Be → n vector X at 800 MeV, 5:34312 (LA-UR—80-1919)
PROTON REACTIONS/CHARMED MESON RESONANCES
Upper limits on phi phi production in 350 GeV/c proton-beryllium collisions, 5:34281 (FERMILAB-CONF—80/57-EXP)
PROTON REACTIONS/COHERENT PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
PROTON REACTIONS/COMPOUND-NUCLEUS REACTIONS
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
PROTON REACTIONS/ELASTIC SCATTERING
Differential cross sections for p + ^{3}He scattering from 19.5 to 47.5 MeV, 5:34313 (LA—8179-MS)
PROTON REACTIONS/INCLUSIVE INTERACTIONS
Slope parameter for the differential cross-section for the reaction p + d → X + d in the region of small momentum transfer at Fermilab energies, 5:34273 (FERMILAB-CONF—80/56-EXP)
PROTON REACTIONS/INELASTIC SCATTERING
Polarization transfer in inelastic scattering, 5:34319 (LA-UR—80-2427)
PROTON REACTIONS/MULTIPLE PRODUCTION
Coherent processes and multiparticle production in hadron-nucleus collisions at high energies, 5:34320 (LBL—8957)
PROTON REACTIONS/PARTICLE PRODUCTION
Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957)
PROTON-ANTIPROTON INTERACTIONS/ANNIHILATION
Search for narrow structures in the anti pp annihilation cross section from 1925 to 1955 MeV, 5:34270 (BNL—28142)

PROTON-ANTIPROTON INTERACTIONS/CROSS SECTIONS
Search for narrow structures in the anti pp annihilation cross section from 1925 to 1955 MeV, 5:34270 (BNL—28142)
PROTON-ANTIPROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
PROTON-NEUTRON INTERACTIONS/SPIN EXCHANGE
Measurement of K/sub NN/, K/sub SS/, K/sub SL/, and K/sub LL/ in polarized np → polarized pn at 800 MeV in the CEX region, 5:34274 (LA-UR—80-1976)
PROTON-PROTON INTERACTIONS/ELASTIC SCATTERING
Elastic scattering of P/sup +-/, π/sup +-/ and K/sup +-/ on protons at high energies and small momentum transfer, 5:34272 (DOE/ER/02232—88)
PROTON-PROTON INTERACTIONS/INCLUSIVE INTERACTIONS
Role of valons in low-p/sub T/ physics, 5:34293 (LA-UR—80-2235)
PROTON-PROTON INTERACTIONS/PARTICLE PRODUCTION
Production of systems with large mass or transverse momentum in high energy hadron-nucleus collisions, 5:34321 (LBL—8957)
PROTON-PROTON INTERACTIONS/REVIEWS
High p/sub T/ transverse momentum physics at the CERN ISR, 5:34283 (LBL—8957)
PSEUDOMONAS/RADIONUCLIDE KINETICS
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
PSI RESONANCES
See also PSI-3105 RESONANCES
PSI RESONANCES/LECTURES
From the psi to charm: The experiments of 1975 and 1976 (Nobel prize lecture), 5:34278
PSI RESONANCES/RADIATIVE DECAY
PSI radiative decays, 5:34291 (SLAC-PUB—2510)
PSI-3105 RESONANCES/RADIATIVE DECAY
Radiative transitions from the psi (3095) to ordinary hadrons, 5:34276 (SLAC-PUB—2519)
PSYCHOLOGY
See BEHAVIOR
PUBLIC BUILDINGS/BUILDING CODES
Energy conservation standards for new nonresidential buildings, 5:33784
PUBLIC BUILDINGS/ENERGY CONSERVATION
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
PUBLIC POLICY/DECISION MAKING
Public reaction to imposed risk, 5:33681 (UCRL—84839)
PWR TYPE REACTORS
See also LOFT REACTOR
NORTH ANNA-1 REACTOR
THREE MILE ISLAND-2 REACTOR
PWR TYPE REACTORS/FUEL CYCLE
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
PWR TYPE REACTORS/PHYSICAL PROTECTION DEVICES
Design concepts to enhance nuclear power plant protection, 5:33612 (SAND—80-1428C)
PWR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Correlation and spectral measurements of fluctuating pressures and velocities in annular turbulent flow, 5:33611 (DOE/ET/34209—T1)
PWR TYPE REACTORS/REACTOR ACCIDENTS
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
PWR TYPE REACTORS/REACTOR CORES
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
PWR TYPE REACTORS/REACTOR INSTRUMENTATION
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
PWR TYPE REACTORS/TEST FACILITIES
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
PYRANOMETERS/SENSITIVITY
Inclination dependence of pyranometer sensitivity, 5:33382
PYRIDINE/COMBUSTION
Cyano-arenes produced by combustion of nitrogen-containing fuels, 5:33175
PYRROLES/ABSORPTION SPECTRA
Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan, 5:34246
PYRROLES/PHOTOIONIZATION
Resonantly enhanced multiphoton ionization of pyrrole, N-methyl pyrrole, and furan, 5:34246

Q

QUANTUM CHROMODYNAMICS/CHIRAL SYMMETRY
Chiral-symmetry breakdown in large-N chromodynamics, 5:34298
QUANTUM CHROMODYNAMICS/REVIEWS
Vacuum structure and QCD, 5:34303 (LBL—8957)
QUANTUM CHROMODYNAMICS/SYMMETRY BREAKING
Chiral-symmetry breakdown in large-N chromodynamics, 5:34298
QUANTUM CHROMODYNAMICS/VACUUM STATES
Nonperturbative vacuum and hard scattering processes, 5:34301 (FERMILAB-CONF—80/68-THY)
QUANTUM FIELD THEORY
See also QUANTUM CHROMODYNAMICS
Exact integrability in quantum field theory, 5:34302 (FERMILAB-CONF—80/69)
QUANTUM FIELD THEORY/EQUATIONS OF MOTION
Does the equation of motion determine commutation relations?, 5:34304
QUANTUM FIELD THEORY/RESEARCH PROGRAMS
Inelastic strong interactions at high energies. Annual progress report, June 1, 1978-May 31, 1979 (Univ. of Cincinnati), 5:34299 (COO—2978-4)
QUANTUM MECHANICS/EQUATIONS OF MOTION
Does the equation of motion determine commutation relations?, 5:34304
QUARK CONFINEMENT
See BAG MODEL
QUARK MODEL
See also BAG MODEL
COLOR MODEL
Role of valons in low-p/sub T/ physics, 5:34293 (LA-UR—80-2235)
QUARK MODEL/HADRON REACTIONS
Quark model and high-energy nuclear experiments, 5:34356 (LBL—8957)
QUARK MODEL/HEAVY ION REACTIONS
Quark model and high-energy nuclear experiments, 5:34356 (LBL—8957)
QUARK MODEL/PROTON-PROTON INTERACTIONS
High p/sub T/ transverse momentum physics at the CERN ISR, 5:34283 (LBL—8957)
QUARK-ANTIQUARK INTERACTIONS/ANNIHILATION
Link-operator formulation of quark confinement without van der Waals forces, 5:34285
QUARKONIUM
See also CHARMONIUM
(Quark)onium theory and spectroscopy, 5:34289 (FERMILAB-CONF—80/63-THY)
QUARTZ/CRACKS
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
QUARTZ/CRYSTAL STRUCTURE
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
QUARTZ/MUON PROBES
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
QUASARS/X RADIATION
X-ray heating and ionization of broad-emission-line regions in QSO's and active galaxies, 5:34236 (PPPL—1683)

R

RACIAL GROUPS
See MINORITY GROUPS
RADIANT HEAT TRANSFER/SCATTERING
Combined radiation convection in thermally developing Poiseuille flow with scattering, 5:34037
RADIATION CHEMISTRY/RESEARCH PROGRAMS
Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Annual progress report, September 1979-July 1980, 5:33937 (DOE/EV/03221—67)
RADIATION DOSIMETRY
See DOSIMETRY
RADIATIVE DECAY/LINE WIDTHS
Two-photon interactions from Mark II at SPEAR, 5:34279 (SLAC-PUB—2517)

RADIO EQUIPMENT
See also HETERODYNE RECEIVERS
RF SYSTEMS
RADIO EQUIPMENT/SQUID DEVICES
Use of SQUIDs in low-frequency communication systems, 5:33970
RADIO RECEIVERS
See RADIO EQUIPMENT
RADIO TRANSMITTERS
See RADIO EQUIPMENT
RADIOACTIVE BIOLOGICAL WASTES
See RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS
See also RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS/ENVIRONMENTAL IMPACTS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
RADIOACTIVE EFFLUENTS/RADIATION HAZARDS
Environmental development plan for special nuclear materials production, 5:34136 (DOE/EDP—0056)
RADIOACTIVE WASTE DISPOSAL/GEOLOGIC DEPOSITS
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
RADIOACTIVE WASTE DISPOSAL/GLOBAL ASPECTS
Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)
RADIOACTIVE WASTE DISPOSAL/LEGAL ASPECTS
Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)
RADIOACTIVE WASTE DISPOSAL/MARINE DISPOSAL
Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
RADIOACTIVE WASTE DISPOSAL/POLITICAL ASPECTS
Overview of the Subseabed Disposal Program, 5:33336 (SAND—80-1606C)
RADIOACTIVE WASTE DISPOSAL/SITE SELECTION
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
RADIOACTIVE WASTE DISPOSAL/UNDERGROUND DISPOSAL
Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
Nuclear waste repository in basalt project B-301 preconceptual design report, 5:33329 (RHO-BWI-CD—35)
Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)
RADIOACTIVE WASTE FACILITIES/AIR QUALITY
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
RADIOACTIVE WASTE FACILITIES/DECOMMISSIONING
Decommissioning of commercial shallow-land burial sites, 5:33318 (PNL-SA—8014)
RADIOACTIVE WASTE FACILITIES/DESIGN
Nuclear waste repository in basalt project B-301 preconceptual design report, 5:33329 (RHO-BWI-CD—35)
RADIOACTIVE WASTE FACILITIES/METEOROLOGY
Meteorological and air quality data quarterly report. WIPP site: Eddy County, New Mexico. Summer quarter, June 1977-August 1977, 5:33339 (SAND—80-7107)
RADIOACTIVE WASTE FACILITIES/SITE SELECTION
Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
RADIOACTIVE WASTE MANAGEMENT
See also RADIOACTIVE WASTE STORAGE
RADIOACTIVE WASTE MANAGEMENT/BIBLIOGRAPHIES
Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979, 5:34108 (USGS-OFR—80-817)
RADIOACTIVE WASTE MANAGEMENT/HIGH-LEVEL RADIOACTIVE WASTES
National perspective on waste management, 5:33313 (DP-MS—80-73)
RADIOACTIVE WASTE MANAGEMENT/LOW-LEVEL RADIOACTIVE WASTES
National perspective on waste management, 5:33313 (DP-MS—80-73)
RADIOACTIVE WASTE MANAGEMENT/MILL TAILINGS
National perspective on waste management, 5:33313 (DP-MS—80-73)
RADIOACTIVE WASTE MANAGEMENT/RESEARCH PROGRAMS
Waste management program technical progress report, July-September 1979 (Savannah River Plant), 5:33312 (DP—79-125-3)
RADIOACTIVE WASTE MANAGEMENT/SPENT FUELS
National perspective on waste management, 5:33313 (DP-MS—80-73)
RADIOACTIVE WASTE MANAGEMENT/TRANSURANIUM ELEMENTS
National perspective on waste management, 5:33313 (DP-MS—80-73)
US Department of Energy acceptance of commercial transuranic waste, 5:33328 (RFP—3110)
RADIOACTIVE WASTE PROCESSING/BIOADSORBENTS
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
RADIOACTIVE WASTE PROCESSING/FLUIDIZED-BED COMBUSTION
Fluidized bed incineration process design for transuranic waste, 5:33320 (RFP—2945)
RADIOACTIVE WASTE PROCESSING/HIGH-LEVEL RADIOACTIVE WASTES
Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes, 5:33316 (DOE/TIC—11219)
RADIOACTIVE WASTE PROCESSING/MILL TAILINGS
Asphalt emulsion sealing of uranium mill tailings. 1979 annual report, 5:33317 (PNL—3290)
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
RADIOACTIVE WASTE PROCESSING/SOLIDIFICATION
Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes, 5:33316 (DOE/TIC—11219)
RADIOACTIVE WASTE PROCESSING/TRANSMUTATION
Transmutation of radwaste using accelerators, 5:33321 (RHO-SA—174)
RADIOACTIVE WASTE STORAGE/CONTAINERS
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
RADIOACTIVE WASTE STORAGE/HIGH-LEVEL RADIOACTIVE WASTES
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
RADIOACTIVE WASTE STORAGE/TRANSURANIUM ELEMENTS
US Department of Energy acceptance of commercial transuranic waste, 5:33328 (RFP—3110)
RADIOACTIVE WASTES
See also HIGH-LEVEL RADIOACTIVE WASTES
LOW-LEVEL RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS
RADIOACTIVE WASTES/BIODEGRADATION
Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Annual report, October 1, 1978-September 30, 1979, 5:33324 (LA—8297-PR)
RADIOACTIVE WASTES/FORECASTING
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
RADIOBIOLOGY/RESEARCH PROGRAMS
Brief description of research papers accepted for publication during 1979. Annual report, 5:34183 (UR—3490-1878)
RADIOCARBON DATING
See CARBON 14
RADIODIAGNOSIS (RADIONUCLIDES)
See NUCLEAR MEDICINE
RADIOFREQUENCY SYSTEMS
See RF SYSTEMS
RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY
RADIOISOTOPE HEAT SOURCES/RESEARCH PROGRAMS
General-purpose heat source project and space nuclear safety and fuels program. Progress report, April 1980, 5:33349 (LA—8454-PR)
RADIOISOTOPE KINETICS
See RADIONUCLIDE KINETICS
RADIOISOTOPE MIGRATION
See RADIONUCLIDE MIGRATION
RADIOISOTOPES/INGESTION
ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides, 5:34193 (DOE/EV/10343—6)

RADIOISOTOPES/INHALATION
ACRO: a computer program for calculating organ doses from acute or chronic inhalation and ingestion of radionuclides, 5:34193 (DOE/EV/10343—6)
RADIONUCLIDE KINETICS
(In living organisms.)
RADIONUCLIDE KINETICS/MEASURING METHODS
Improved methods for measuring radioactive tracer accumulation and excretion by microarthropods, with applications for a mite species, Tyrophagus longior (Acarina, Acaridae), 5:34171 (DOE/EV/00641—38)
RADIONUCLIDE MIGRATION
(In environment.)
RADIONUCLIDE MIGRATION/AQUATIC ECOSYSTEMS
Abstracts from a workshop on processes determining the input, behavior and fate of radionuclides and trace elements in continental shelf environments, 5:34164 (CONF-790382—(Absts.))
RADIONUCLIDE MIGRATION/MATHEMATICAL MODELS
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
RADIONUCLIDE MIGRATION/RADIATION MONITORING
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
RADIONUCLIDES
See RADIOISOTOPES
RADIOPHARMACEUTICALS/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
RADIOSURGERY
See RADIOTHERAPY
RADIOTHERAPY/NEUTRON SOURCES
10^{13}/second 14 MeV neutron generator for cancer therapy, 5:34084 (SAND—80-1388C)
RADIUM/UPTAKE
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
RADIUM 226/RADIOECOLOGICAL CONCENTRATION
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
RADON/GAS FLOW
Uranium mill tailings stabilization, 5:33319 (PNL-SA—8414)
RADON/INHALATION
Estimating population health risk from low-level environmental radon, 5:34192 (PNL-SA—8291)
RADON/RADIATION MONITORING
Operating instructions for LBL radon measurement facilities, 5:34137 (LBL—11097)
RADON/RADIOECOLOGICAL CONCENTRATION
Radon monitoring program, February-April 1980, 5:34139 (MLM—2758)
RAFT RIVER VALLEY/GEOTHERMAL WELLS
Moderate temperature geothermal: a direct source of process energy, 5:33577 (CONF-801014—1)
RAILWAYS/FUEL SUBSTITUTION
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
RAILWAYS/FUELS
Alternative energy sources for non-highway transportation: executive summary, 5:33787 (DOE/CS/05438—T1(Vol.1))
Alternative energy sources for non-highway transportation: technical section, 5:33788 (DOE/CS/05438—T1(Vol.2))
RANKINE CYCLE ENGINES/FUEL CONSUMPTION
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
RANKINE CYCLE ENGINES/PERFORMANCE TESTING
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
RANKINE CYCLE ENGINES/TECHNOLOGY ASSESSMENT
Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
RARE EARTH NUCLEI/ENERGY LEVELS
Bandcrossing in K unequal 0 bands, 5:34339
RARE EARTH NUCLEI/ROTATIONAL STATES
Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
RARE EARTHS
See also CERIUM
DYSPROSIUM
ERBIUM
EUROPIUM
LANTHANUM
LUTETIUM
SAMARIUM
YTTERBIUM
RARE EARTHS/CATALYTIC EFFECTS
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
RARE GASES
See also ARGON
HELIUM
KRYPTON
NEON
RADON
XENON
RARE GASES/DIFFUSION
Mound Facility activities in chemical and physical research: July-December 1979, 5:33939 (MLM—2727)
RATE STRUCTURE
Electric Utility Rate Design Study: comments on RDS Report No. 66, An Evaluation of Four Marginal Costing Methodologies, 5:33728
RATE STRUCTURE/EVALUATION
Electric Utility Rate Design Study: the accounting-cost basis for evaluating block rates, 5:33725
RATE STRUCTURE/FORECASTING
Marginal cost of electricity 1980-1995: an approximation based on the cost of new coal and nuclear generating plants, 5:33592 (PNL—3458)
RATE STRUCTURE/LOAD MANAGEMENT
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 5:33727
RATE STRUCTURE/TIME-OF-USE PRICING
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
RAW MATERIALS/MINING
Directory of Washington mining operations, 1979, 5:33682
RAYLEIGH-TAYLOR INSTABILITY/SIMULATION
Vortex simulations of the Rayleigh—Taylor instability, 5:34265
RAYLEIGH-TAYLOR INSTABILITY/VORTICES
Vortex simulations of the Rayleigh—Taylor instability, 5:34265
RDF
See REFUSE DERIVED FUELS
REACTOR ACCIDENTS
See also MELTDOWN
REACTOR ACCIDENTS/REACTOR INSTRUMENTATION
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
REACTOR CORES/BURNUP
Development, implementation, and verification of multicycle depletion perturbation theory for reactor burnup analysis, 5:33628 (ORNL/TM—7305)
REACTOR DECOMMISSIONING/OPTIMIZATION
Optimization of costs versus radiation exposures in decommissioning, 5:33627 (PNL-SA—8017)
REACTOR INSTRUMENTATION/LEVEL INDICATORS
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
REACTOR INSTRUMENTATION/PERFORMANCE
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
REACTOR INSTRUMENTATION/THERMOCOUPLES
Meeting commercial reactor instrumentation needs, 5:33610 (CONF-800747—5)
REACTOR MATERIALS
(See also specific materials.)
See also MATRIX MATERIALS
REACTOR MATERIALS/CORROSION
Review of the CEA research and development activities in the field of structural materials for fast breeder reactors, 5:33615 (DOE/CEA/BMFT—13)
REACTOR MATERIALS/FRACTURE PROPERTIES
Review of the CEA research and development activities in the field of structural materials for fast breeder reactors, 5:33615 (DOE/CEA/BMFT—13)
REACTOR MATERIALS/RESEARCH PROGRAMS
Review of the CEA research and development activities in the field of structural materials for fast breeder reactors, 5:33615 (DOE/CEA/BMFT—13)
REACTOR SAFETY EXPERIMENTS/DENSITOMETERS
Gamma scattering, 5:34087 (CONF-800747—3)
REACTOR SITING
See SITE SELECTION
RECTIFIERS/PERFORMANCE
Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
RECYCLE (FUEL)
See FUEL CYCLE

REFRACTORIES/CORROSION
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
REFRACTORIES/MATERIALS TESTING
Materials technology for coal-conversion processes. Progress report, January-March 1980, 5:33173 (ANL—80-46)
REFRIGERANTS
See also FREONS
REFRIGERANTS/HEAT RECOVERY
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
REFRIGERATING MACHINERY
See also REFRIGERATORS
REFRIGERATING MACHINERY/ENERGY CONSERVATION
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
REFRIGERATING MACHINERY/REFRIGERANTS
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
REFRIGERATORS/FABRICATION
Design and construction of microminiature cryogenic regrigerators, 5:34012
REFRIGERATORS/MINIATURIZATION
Design and construction of microminiature cryogenic regrigerators, 5:34012
REFUSE
See SOLID WASTES
REFUSE DERIVED FUELS
See also MUNICIPAL WASTES
SOLID WASTES
SYNTHETIC FUELS
REFUSE DERIVED FUELS/COMBUSTION
New technological developments in processing solid waste to energy, 5:33815
REFUSE-FUELED POWER PLANTS/AGRICULTURAL WASTES
Crop residues as a fuel for power generation, 5:33414 (BNL—50982)
REFUSE-FUELED POWER PLANTS/FEASIBILITY STUDIES
Crop residues as a fuel for power generation, 5:33414 (BNL—50982)
REGENERATIVE FUEL CELLS/COST
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
REGENERATIVE FUEL CELLS/EVALUATION
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
REGENERATORS/MATERIALS
Regenerator matrix physical property data, 5:33821 (DOE/NASA/0008—80/11)
REGION I
See NORTH ATLANTIC REGION
REGION VI
See SOUTHWEST REGION
REGION X
See PACIFIC NORTHWEST REGION
REGULATORS (VOLTAGE)
See VOLTAGE REGULATORS
REINFORCED CONCRETE/COMPARATIVE EVALUATIONS
Development of a glass polymer composite sewer pipe from waste glass. Final report, 5:33908 (BNL—51194)
RELIABILITY/FAULT TREE ANALYSIS
Extension and validation of fault-tree analysis for reliability prediction. Final report, 5:33734 (EPRI-AP—1510)
RENE 80/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENE 80/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENE 80/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENE-100/CORROSION RESISTANCE
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENE-100/CREEP
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENE-100/PHYSICAL PROPERTIES
Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, January 1, 1980-March 31, 1980, 5:33857 (COO—2975-43)
RENEWABLE ENERGY SOURCES
See also BIOMASS
GEOTHERMAL ENERGY
HYDROELECTRIC POWER
SOLAR ENERGY
WIND POWER
RENEWABLE ENERGY SOURCES/COMMERCIALIZATION
Commercial status: electrical generation and nongeneration technologies, 5:33712 (P—102-80-004)
RENEWABLE ENERGY SOURCES/ENVIRONMENTAL IMPACTS
Environmental aspects of renewable energy sources, 5:33680 (UCB/ERG—80-1)
RENEWABLE ENERGY SOURCES/INFORMATION NEEDS
Developing common information elements for renewable energy systems: summary and proceedings of the SERI/AID workshop, 5:33744 (SERI/TP—744-661)
RENEWABLE ENERGY SOURCES/MEETINGS
Developing common information elements for renewable energy systems: summary and proceedings of the SERI/AID workshop, 5:33744 (SERI/TP—744-661)
RENEWABLE ENERGY SOURCES/POWER GENERATION
Estimating utilities' prices for power purchases from alternative energy resources, 5:33739 (P—500-80-015)
RENEWABLE ENERGY SOURCES/RECYCLING
Supplementing the energy and plant nutrient requirements through organic recycling, 5:33791 (CONF-800396—1)
RENEWABLE ENERGY SOURCES/SOCIO-ECONOMIC FACTORS
Macroeconomic effects of accelerated implementation of renewable energy technologies in the US, 5:33368 (BNL—51092)
RESEARCH PROGRAMS
See also DEMONSTRATION PROGRAMS
Annual highlights of programs in energy science (Chemistry; materials; process), 5:34438 (BNL—50973)
RESEARCH PROGRAMS/EVALUATION
Ranking methodology, 5:34197 (BNL—51118)
RESEARCH PROGRAMS/PLANNING
Climate effects workshop, 5:34134 (UCRL—84677)
RESERVOIR ROCK/POROSITY
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
RESIDENTIAL BUILDINGS
See also APARTMENT BUILDINGS
HOUSES
RESIDENTIAL BUILDINGS/ENERGY CONSERVATION
Energy conserving site design: Greenbrier case study, Chesapeake, Virginia. Final report, 5:33800 (DOE/CS/24216—1)
Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
RESIDENTIAL BUILDINGS/ENERGY CONSUMPTION
Potential for energy technologies in residential and commercial buildings, 5:33775 (DOE/PE/03871—T1)
Uncertainties in our understanding of energy conservation, 5:33774 (CONF-800835—2)
RESIDENTIAL BUILDINGS/HEATING SYSTEMS
Direct efficiency measurement and analysis of residential oil-fired boiler systems: burner-boiler/furnace efficiency test project. Annual report FY 1978, 5:33773 (BNL—51171)
RESIDENTIAL BUILDINGS/ORIENTATION
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
RESIDENTIAL BUILDINGS/PHOTOVOLTAIC POWER SUPPLIES
Solar photovoltaic systems for residences in the Northeast, 5:33445 (DOE/ET/20279—100)
RESIDENTIAL BUILDINGS/SITE SELECTION
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
RESIDENTIAL BUILDINGS/SOLAR SPACE HEATING
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
RESIDENTIAL BUILDINGS/SOLAR WATER HEATING
Solar energy economics for the county of Santa Barbara, 5:33510 (NP—25017)

Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
RESIDENTIAL SECTOR/ENERGY CONSERVATION
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)
Residential energy conservation, 5:33782 (OTA-E—92(Vol.1))
RESIDENTIAL SECTOR/HEATING OILS
Geothermal Energy Market Study on the Atlantic Coastal Plain: a review of recent energy price projections for traditional space and process heating fuels in the post-1985 period, 5:33776 (JHU/APL-GEM—007)
RESIDENTIAL SECTOR/LAND USE
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)
RESIDENTIAL SECTOR/REFRIGERATING MACHINERY
Assessment of the potential for heat recovery and load leveling on refrigeration systems. Volume 1. Summary. Final report, 5:33760 (EPRI-EM—1348(Vol.1))
RESIDUAL FUELS/TRANSPORT
Residual fuel compositions with low pour points (Patent), 5:33276
RESIDUAL PETROLEUM/FORECASTING
Application of statistical estimation theory to the determination of porosity and residual oil saturation, 5:33249 (SAND—80-1292)
RESIDUES
See also ASHES
RESIDUES/WASTE PRODUCT UTILIZATION
Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979, 5:33219 (DOE/ET/10533—9)
RESIDUES (RADIOACTIVE)
See RADIOACTIVE WASTES
RESINS/SOLVENT EXTRACTION
Chemical class fractionation and thermophysical property measurements of solvent refined coal liquids, 5:33214 (CONF-800814—9)
RESONANCE CAVITIES
See CAVITY RESONATORS
RESOURCE ASSESSMENT/MEETINGS
Resources for an uncertain future, 5:33687
RESOURCE DEVELOPMENT/ENVIRONMENTAL IMPACTS
Simulation approach to a regional resource environment conflict, 5:34166 (CONF-800819—2)
RESOURCE RECOVERY FACILITIES/TECHNOLOGY ASSESSMENT
New technological developments in processing solid waste to energy, 5:33815
RESPIRATORY SYSTEM DISEASES/RISK ASSESSMENT
Estimating population health risk from low-level environmental radon, 5:34192 (PNL-SA—8291)
RETORTED SHALES
See SPENT SHALES
RETROFITTING/LIFE-CYCLE COST
Life-cycle costing: a guide for selecting energy-conservation projects for public buildings, 5:33785 (NBS-BSS—113)
RETROFITTING/THERMAL INSULATION
Massachusetts study of the retrofit insulation industry, 5:33771
REVERSE COMBUSTION/MATHEMATICAL MODELS
Analysis of reverse combustion in tar sands: a one-dimensional model, 5:33290 (DOE/LETC—1761-2/1)
REVERSE COMBUSTION/SIMULATION
Analysis of reverse combustion in tar sands: a one-dimensional model, 5:33290 (DOE/LETC—1761-2/1)
REVERSE-FIELD PINCH
Incomplete relaxation and finite beta plasmas, 5:34402 (LA-UR—80-2043)
REVERSE-FIELD PINCH/JOULE HEATING
Stable heating and burn simulations of a reversed-field pinch reactor, 5:34415 (LA-UR—80-2500)
REVERSE-FIELD PINCH/MAGNETIC ISLANDS
Magnetic islands and stochastic field lines in the RFP, 5:34414 (LA-UR—80-2406)
REVERSE-FIELD PINCH/REACTOR START-UP
Stable heating and burn simulations of a reversed-field pinch reactor, 5:34415 (LA-UR—80-2500)
REVERSE-FIELD PINCH/STOCHASTIC PROCESSES
Magnetic islands and stochastic field lines in the RFP, 5:34414 (LA-UR—80-2406)
REVERSE-FIELD PINCH/THERMONUCLEAR IGNITION
Stable heating and burn simulations of a reversed-field pinch reactor, 5:34415 (LA-UR—80-2500)
RF SYSTEMS
See also RADIO EQUIPMENT
RF SYSTEMS/ENERGY STORAGE SYSTEMS
RF Energy Compressor, 5:34059 (SLAC-PUB—2480)
RHENIUM/FABRICATION
Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace, 5:33852 (HEDL-SA—2189)
RHENIUM/SURFACE COATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
RHENIUM ALLOYS/FABRICATION
Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace, 5:33852 (HEDL-SA—2189)
RHODE ISLAND/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
RHODIUM/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
RHODIUM/SURFACE COATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
RHYOLITES/AGE ESTIMATION
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
RHYOLITES/CHEMICAL ANALYSIS
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
RHYOLITES/PETROGRAPHY
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
RIEMANN WAVES
See SHOCK WAVES
RINGS (STORAGE)
See STORAGE RINGS
RISER CRACKING
See COAL LIQUEFACTION
RISK ASSESSMENT
Daily risks of life, 5:33678 (CONF-800212—)
RISK ASSESSMENT/POLITICAL ASPECTS
Political side of risk: a new approach, 5:33675 (SAND—80-1871C)
RISK ASSESSMENT/PUBLIC OPINION
Political side of risk: a new approach, 5:33675 (SAND—80-1871C)
ROCK BEDS/PERFORMANCE
Rock bed behavior and reverse thermosiphon effects, 5:33545 (LA-UR—80-2429)
ROCK BEDS/THERMOSYPHON EFFECT
Rock bed behavior and reverse thermosiphon effects, 5:33545 (LA-UR—80-2429)
ROCKS
See also RESERVOIR ROCK
ROCKS/CHEMICAL COMPOSITION
Compilation of elemental concentration data for the United States geological survey's six geochemical exploration reference materials, 5:34229 (LA—8473-MS)
ROCKS/CRACKS
Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
ROCKS/WAVE PROPAGATION
Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
ROD DROP METHOD/REACTIVITY WORTHS
Hybrid inverse kinetics method combining the Yang-Albrecht and three point techniques (LMFBR), 5:33620 (HEDL-TME—79-78)
ROOSEVELT HOT SPRINGS/GEOCHEMICAL SURVEYS
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
ROOSEVELT HOT SPRINGS/GEOLOGY
Model study of the regional hydrogeologic regime, Roosevelt Hot Springs, Utah, 5:33552 (DOE/ET/28392—44)
ROOSEVELT HOT SPRINGS/GEOTHERMAL WELLS
Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
ROOSEVELT HOT SPRINGS/HYDROLOGY
Model study of the regional hydrogeologic regime, Roosevelt Hot Springs, Utah, 5:33552 (DOE/ET/28392—44)
RUBIDIUM/ELECTRON COLLISIONS
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
RUBIDIUM/SORPTIVE PROPERTIES
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)

RUTHENIUM/CATALYTIC EFFECTS
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
RUTHENIUM BORIDES/COLD WORKING
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
RUTHENIUM BORIDES/MAGNETIC FLUX
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906
RUTHENIUM BORIDES/SUPERCONDUCTIVITY
Effects of cold rolling on fluxoid pinning in a superconducting metallic glass, 5:33906

S

SACCHAROMYCES CEREVISIAE/RADIONUCLIDE KINETICS
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
SALINITY GRADIENT POWER PLANTS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
SALMON/AQUACULTURE
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
SALT DEPOSITS
Recommended new criteria for the selection of nuclear waste repository sites in Columbia River basalt and US Gulf Coast domed salt, 5:33337 (UCRL—52749)
SALT DEPOSITS/CREEP
Simulation of a bench scale experiment with an empirical creep law. Technical report, 5:34227 (ONWI—99)
SALT DEPOSITS/RADIATION EFFECTS
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
SALT DEPOSITS/STRESS ANALYSIS
Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)
SALT DEPOSITS/TEMPERATURE EFFECTS
Expected environments in high-level nuclear waste and spent fuel repositories in salt, 5:33327 (ORNL/TM—7201)
SALT DEPOSITS/WELL LOGGING
Basic data report for drillhole WIPP 30 (Waste Isolation Pilot Plant - WIPP), 5:33330 (SAND—79-0284)
SAMARIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
SAMARIUM 150 TARGET/TRITON REACTIONS
Single-proton states in ^{149}Pm (From ^{150}Sm(t,α) at 17 MeV), 5:34334
SAMARIUM 154 TARGET/ARGON 40 REACTIONS
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
SAMARIUM ALLOYS/DEHYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
SAMARIUM ALLOYS/HYDRIDATION
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
SANDIA LABORATORIES/SECURITY
Microcomputer closed circuit television controller, 5:34056 (SAND—79-0688)
SANDIA LABORATORIES/SIMULATORS
Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
SANDSTONES/PHYSICAL PROPERTIES
Experimental study of the response of the Galesville sandstone to simulated CAES conditions, 5:33635 (PNL—3399)
SATELLITE POWER SYSTEM
See ORBITAL SOLAR POWER PLANTS
SATELLITE SOLAR POWER STATIONS
See ORBITAL SOLAR POWER PLANTS
SATELLITES/GYROSCOPES
Signal detection in 1/f noise of SQUID magnetometers, 5:33977
SAVANNAH RIVER PLANT/BAYS
Locations and areas of ponds and Carolina Bays at the Savannah River Plant, 5:34154 (DP—1525)
SAVANNAH RIVER PLANT/PONDS
Locations and areas of ponds and Carolina Bays at the Savannah River Plant, 5:34154 (DP—1525)
SAVANNAH RIVER PLANT/RADIOACTIVE WASTE MANAGEMENT
Waste management program technical progress report, July-September 1979, 5:33312 (DP—79-125-3)
SCANDIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
SCANDIUM HYDRIDES/OPTICAL PROPERTIES
Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)
SCATTERING/INTEGRAL EQUATIONS
Few-body scattering integral equation approach, 5:34306 (CONF-800829—4)
SCATTERING/SEMICLASSICAL APPROXIMATION
Scattering in the quasiperiodic and stochastic regimes, 5:34308 (CONF-800829—7)
SCATTERING/VARIATIONAL METHODS
Variable interval variable step method for the solution of linear second order coupled differential equations, 5:34383
SCHOOL BUILDINGS/BUILDING CODES
Energy conservation standards for new nonresidential buildings, 5:33784
SCHOOL BUILDINGS/ENERGY CONSERVATION
Preliminary energy-conservation opportunities for schools, hospitals, municipalities, and industries., 5:33786
SCHOOL BUILDINGS/SOLAR SPACE HEATING
Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi, 5:33470 (DOE/NASA/CR—161509)
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
Solar space heating for the visitors' center, Stephens College, Columbia, Missouri. Final report, 5:33467 (DOE/NASA/CR—161485)
SCHOOL BUILDINGS/SOLAR WATER HEATING
Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi, 5:33470 (DOE/NASA/CR—161509)
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
SCHOOL FACILITIES
See EDUCATIONAL FACILITIES
SCHOOL PLANT
See EDUCATIONAL FACILITIES
SCHOTTKY BARRIER DIODES/FABRICATION
Schottky barrier formation by laser irradiation processing, 5:34060
SCINTIGRAPHY
See SCINTISCANNING
SCINTISCANNING/RESEARCH PROGRAMS
Annual report 1978 and final report 1979, 5:34174 (FMI—45)
SEALS/PERFORMANCE TESTING
Flywheel Seal Test Program, 5:33638 (SAND—80-7019)
SEAS
See also PACIFIC OCEAN
SEAS/TEMPERATURE GRADIENTS
The expanded ocean thermal-structure analysis system: a development based on the fields by information blending methodology. Final report, 5:34231 (AD-A—076534)
SEAWEEDS/ANAEROBIC DIGESTION
Anaerobic digestion of kelp, 5:33427 (NP—25045)
SEAWEEDS/CULTIVATION TECHNIQUES
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)
SEDIMENTS/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
SEDIMENTS/CHEMICAL ANALYSIS
Stream sediment detailed geochemical survey for Date Creek Basin, Arizona, 5:33304 (GJBX—164(80))
SEDIMENTS/GEOCHEMISTRY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
SEDIMENTS/HYDROLOGY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
SEDIMENTS/PHYSICAL PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
SEDIMENTS/RADIOCHEMICAL ANALYSIS
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
SEDIMENTS/TEMPERATURE EFFECTS
Analysis of heat and mass transfer in sub-seabed disposal of nuclear waste, 5:33334 (SAND—80-0312C)

SEDIMENTS/THERMODYNAMIC PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
SEEDS/DRYING
Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
SEEDS/MICROWAVE DRYERS
Microwave-vacuum drying system (MIVAC). Progress report No. 4, 5:33794 (DOE/CS/40031—T1)
SELENIUM/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
SELENIUM 76/HIGH SPIN STATES
High-spin states and band structure in ^{76}Se, 5:34327
SELENIUM 76/NUCLEAR STRUCTURE
High-spin states and band structure in ^{76}Se, 5:34327
SELENIUM 77/NUCLEAR MAGNETIC RESONANCE
Confirmation of McMillan's concept of "discommensurations", 5:33875
SELENIUM ALLOYS/SURFACE PROPERTIES
Normal emission photoelectron diffraction: a new technique for determining surface structure, 5:34099 (LBL—11017)
SELEXOL PROCESS
High CO_2-high H_2S removal with SELEXOL solvent, 5:33282
SEMICONDUCTOR DEVICES
See also SEMICONDUCTOR LASERS
SEMICONDUCTOR DEVICES/FABRICATION
Semiconductor chip processing. Final report, 5:34052 (BDX—613-2466)
SEMICONDUCTOR DEVICES/RESEARCH PROGRAMS
Superconductor-semiconductor device research, 5:34004
SEMICONDUCTOR LASERS/FABRICATION
Electrooptical devices. Semiannual technical summary report, 1 October 1978-31 March 1979, 5:34030 (AD-A—077153)
SEMICONDUCTOR LASERS/LIFETIME
Electrooptical devices. Semiannual technical summary report, 1 October 1978-31 March 1979, 5:34030 (AD-A—077153)
SENEGAL/ENERGY CONSUMPTION
Energy consumption: case of the Ivory Coast, Senegal and Ghana (Electricity and gasoline), 5:33743
SEWAGE/RECYCLING
Organic recycling in agriculture, 5:33814 (NP—25012)
SEWAGE/WASTE PRODUCT UTILIZATION
Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
SEWAGE SLUDGE/ANAEROBIC DIGESTION
Conversion of urban refuse to substitute natural gas by the Biogas Process, 5:33357
SEWAGE SLUDGE/RADIODISINFESTATION
Irradiation of sewage sludge using cesium-137: a comparative assessment, 5:33348 (SAND—80-7097)
SHALE OIL/CATALYTIC CRACKING
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253
SHALE OIL/DESULFURIZATION
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253
Sorbent regeneration in a process for removing sulfur-containing impurities from mineral oils (Patent), 5:33257
SHALE OIL/HYDROGENATION
Combination residual oil hydrodesulfurization and catalytic cracking process (Patent), 5:33253
Raw shale oil upgrading, 5:33295
SHALE OIL/MASS BALANCE
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
SHALE OIL/QUANTITATIVE CHEMICAL ANALYSIS
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
SHALE OIL/REFINING
Raw shale oil upgrading, 5:33295
Synthetic fuels from oil shale: symposium papers, 5:33287
SHALE OIL/STRUCTURAL CHEMICAL ANALYSIS
High resolution NMR spectroscopy: its application to shale oil component/type analysis, 5:33298
SHELL MODELS/CENTER-OF-MASS SYSTEM
Centre-of-mass spuriosity in continuum shell-model calculations, 5:34364
SHIFT PROCESSES/CATALYSTS
Combined shift and methanation in a fluidized-bed reactor. Quarterly progress report, 1 April-30 June 1980, 5:33183 (DOE/ET/14815—12)
SHIPMENT
See TRANSPORT
SHIVA FACILITY/REVIEWS
Progress of laser fusion at Lawrence Livermore Laboratory, 5:34425
SHOCK WAVES/CHEMICAL REACTIONS
Bibliography on shock-induced chemistry, 5:33931 (SAND—80-1642)
SHOWER COUNTERS
(Detects high energy gamma radiation or high energy particles on basis of cascade showers in layered absorbers.)
SHOWER COUNTERS/FEASIBILITY STUDIES
New ideas in calorimetry, 5:34093 (BNL—28132)
SHOWER COUNTERS/RESOLUTION
Some energy resolution effects for hadron jets in a calorimeter array, 5:34094 (COO—3071-245)
SHOWER COUNTERS/SCINTILLATION COUNTERS
New ideas in calorimetry, 5:34093 (BNL—28132)
SHOWER COUNTERS/SPECIFICATIONS
Uranium scintillator calorimeter at the CERN ISR, 5:34080 (BNL—28214)
SHRIMP/AQUACULTURE
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
SILICA/CATALYTIC EFFECTS
Hydrocarbon cracking catalyst (Patent), 5:33255
SILICA/REMOVAL
Removal of silica from Raft River geothermal water, 5:33570 (EGG-FM—5170)
SILICATES/ISOTOPE RATIO
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
SILICIC ACID/CRACKS
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
SILICIC ACID/CRYSTAL STRUCTURE
Hydrogen-for-lithium exchange in lithium aluminosilicate ceramics. I. Microcracking, 5:33915 (SAND—80-1838C)
SILICON/ABSORPTIVITY
Chemical vapor deposited amorphous silicon for use in photothermal conversion, 5:33534
SILICON/AMORPHOUS STATE
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
SILICON/ANNEALING
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
SILICON/CHEMICAL VAPOR DEPOSITION
Chemical vapor deposited amorphous silicon for use in photothermal conversion, 5:33534
Thin film polycrystalline silicon solar cells: first technical progress report, April 15, 1980-July 15, 1980, 5:33412 (SERI/PR—9192-1-T1)
SILICON/CORROSION RESISTANCE
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
SILICON/CRYSTAL GROWTH
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
SILICON/CRYSTAL STRUCTURE
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
SILICON/ELECTROPLATING
Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. Second quarterly progress report, January 1-March 31, 1980, 5:33410 (SERI/PR—8119-2-T2)
Low-cost substrates for polycrystalline silicon solar cells by electrodeposition processes. First quarterly progress report, October 1-December 31, 1979, 5:33409 (SERI/PR—8119-2-T1)
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
SILICON/EPITAXY
Efficient solar cells by space processing. Final report, October 1, 1978-December 14, 1979, 5:33404 (IS—4723)
Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 3, 25 March-24 June 1980, 5:33406 (SERI/PR—0-8274-3)
SILICON/EXCITONS
Kinetics of excitons, biexcitons and free carriers in Si, 5:34373 (SAND—80-1697C)
SILICON/GRAIN BOUNDARIES
Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980, 5:33407 (SERI/PR—0-8276-3)
SILICON/LASER-RADIATION HEATING
Si and Ge (111) surface structures after pulsed laser annealing, 5:33916
SILICON/MUON PROBES
DEMUR: double electron muon resonance, 5:34252 (LA-UR—80-2374)
SILICON/MUONIUM
Review of the experimental results on impurity centers in elemental semiconductors obtained by μSR and other techniques, 5:34255 (LA-UR—80-2377)

Temperature dependence of anomalous muonium hyperfine interactions in silicon, 5:34251 (LA-UR—80-2373)
SILICON/PHOTOCONDUCTIVITY
Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980, 5:33407 (SERI/PR—0-8276-3)
SILICON/PLASMA ARC SPRAYING
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
SILICON/PRODUCTION
Silicon processes, 5:33397 (BNL—51118)
SILICON/PURIFICATION
Thin film polycrystalline silicon solar cells: first technical progress report, April 15, 1980-July 15, 1980, 5:33412 (SERI/PR—9192-1-T1)
SILICON/SURFACE PROPERTIES
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
SILICON/VACUUM COATING
Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly report, 1 April-30 June 1980, 5:33411 (SERI/PR—8278-1-T3)
SILICON 24/MASS
Isospin quintets in the 1p and s-d shells, 5:34318
SILICON 28 TARGET/TRITON REACTIONS
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)
SILICON ALLOYS/MAGNETIC PROPERTIES
Annealing behavior of high permeability amorphous alloys, 5:33869 (LBL—10995)
SILICON CARBIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
SILICON COMPOUNDS/PHYSICAL RADIATION EFFECTS
Reversible changes in the oscillator strengths of Si-H vibrations in a-Si:H induced by He^+-ion bombardment, 5:33920
SILICON NITRIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)
SILICON SOLAR CELLS/FABRICATION
Efficient solar cells by space processing. Final report, October 1, 1978-December 14, 1979, 5:33404 (IS—4723)
Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 3, 25 March-24 June 1980, 5:33406 (SERI/PR—0-8274-3)
Metal-insulator-semiconductor photovoltaic devices, 5:33405 (PNL-SA—7778)
Phase 2 of the array automated assembly task for the Low Cost Solar Array Project. Final report, October 1, 1978-October 30, 1979, 5:33403 (DOE/JPL/954873—8)
Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980, 5:33407 (SERI/PR—0-8276-3)
Thin film polycrystalline silicon solar cells: first technical progress report, April 15, 1980-July 15, 1980, 5:33412 (SERI/PR—9192-1-T1)
Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly report, 1 April-30 June 1980, 5:33411 (SERI/PR—8278-1-T3)
SILICON SOLAR CELLS/GRAIN BOUNDARIES
Thin-film polycrystalline silicon solar cells. Technical progress quarterly report No. 3, 25 March 1980-24 June 1980, 5:33407 (SERI/PR—0-8276-3)
SILICON SOLAR CELLS/PERFORMANCE
Metal-insulator-semiconductor photovoltaic devices, 5:33405 (PNL-SA—7778)
Thin film polycrystalline silicon solar cells: first technical progress report, April 15, 1980-July 15, 1980, 5:33412 (SERI/PR—9192-1-T1)
SILICON SOLAR CELLS/RESEARCH PROGRAMS
Photovoltaic programs at RCA, 5:33399 (BNL—51118)
SILVER/LIGHT TRANSMISSION
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
SILVER/SPECTRAL REFLECTANCE
Thermomodulation spectra of high-energy interband transitions in Cu, Pd, Ag, Pt, and Au, 5:33878
SILVER 107 TARGET/NEUTRON REACTIONS
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, 15 to 40 MeV), 5:34337
SILVER 108/PION MINUS REACTIONS
Multiplicity correlations in high-energy hadron-nucleus collisions (20 and 37 GeV/c), 5:34342 (LBL—8957)
SILVER ALLOYS/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
SIMULATORS/DESIGN
Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
SIMULATORS/OPERATION
Sandia Laboratories hybrid computer and motion simulator facilities, 5:33950 (SAND—80-0697)
SITE SELECTION/LEGAL ASPECTS
Refinery siting workbook: appendices A and B, 5:33225 (DOE/RA/33001—01(Vol.1))
Refinery siting workbook: appendices C to O, 5:33274 (DOE/RA/33001—01(Vol.2))
SITE SELECTION/SOCIO-ECONOMIC FACTORS
Refinery siting workbook: appendices A and B, 5:33225 (DOE/RA/33001—01(Vol.1))
SLABS/MELTING
Computational experience with an explicit difference scheme for a one phase Stefan problem, 5:34388 (ORNL/CSD—62)
SLUGS (FUEL)
See FUEL RODS
SMECTITE/ION EXCHANGE
Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)
SMECTITE/PHYSICAL PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
SMECTITE/THERMODYNAMIC PROPERTIES
Thermophysical properties of deep ocean sediments, 5:33335 (SAND—80-1533C)
SNG PLANTS
See also HIGH BTU GAS
SNG PLANTS/ALLOCATIONS
Environmental assessment: allocation of petroleum feedstock, Columbia LNG Corporation, Green Springs SNG Plant, Green Springs, Seneca County, Ohio, 5:33269 (DOE/EA—0061)
SODIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
SODIUM/CATALYTIC EFFECTS
Catalysis of lignite char gasification by various exchanged cations - dependence of activity on reactive atmosphere, 5:33194
SODIUM/CRYSTAL STRUCTURE
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
SODIUM/F CENTERS
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
SODIUM/ION-ATOM COLLISIONS
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1979-May 31, 1980, 5:34256 (COO—2718-8)
SODIUM/PHYSICAL PROPERTIES
Electron paramagnetic resonance studies of beta-alumina, a prototype glass, 5:33902 (DOE/ER/01198—134)
SODIUM 23/ENERGY LEVELS
Nonstatistical effects in the $^{12}C(^{15}N,\alpha)$ reaction, 5:34322
SODIUM BROMIDES/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
SODIUM CHLORIDES/CRACKS
Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
SODIUM CHLORIDES/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
SODIUM CHLORIDES/WAVE PROPAGATION
Analysis of microcracks in dry polycrystalline NaCl by ultrasonic signal processing, 5:34049 (UCRL—52975)
SODIUM-SULFUR BATTERIES/CATHODES
Sulfur electrode for sodium-sulfur batteries (Patent; fabrication), 5:33659
SODIUM-SULFUR BATTERIES/SEALS
Double seal for sodium sulfur battery (Patent), 5:33658
SOILS/CHEMICAL COMPOSITION
Compilation of elemental concentration data for the United States geological survey's six geochemical exploration reference materials, 5:34229 (LA—8473-MS)
SOILS/RADIOCHEMICAL ANALYSIS
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
SOILS/RADIONUCLIDE MIGRATION
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
Redox reactions involving chromium, plutonium, and manganese in soils, 5:34150 (DOE/DP/04515—1)
SOILS/SORPTIVE PROPERTIES
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
SOJA BEAN OIL
See SOYBEAN OIL

SOLAR ABSORBERS/FABRICATION
Chemical vapor deposited amorphous silicon for use in photothermal conversion, 5:33534
SOLAR ABSORBERS/SOLAR COLLECTORS
Chemical vapor deposited molybdenum films for use in photothermal conversion, 5:33533
SOLAR ACCESS
See SOLAR RIGHTS
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
SOLAR ACCESS/LEGAL ASPECTS
Protecting solar access: a guidebook for California communities, 5:33389 (P—500-80-013)
SOLAR ACCESS/PLANNING
Protecting solar access: a guidebook for California communities, 5:33389 (P—500-80-013)
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
SOLAR ACCESS/REGULATIONS
Protecting solar access: a guidebook for California communities, 5:33389 (P—500-80-013)
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
SOLAR AIR CONDITIONERS
Solar systems for heating and cooling, 5:33489
SOLAR AIR CONDITIONERS/DEMONSTRATION PROGRAMS
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
SOLAR AIR CONDITIONERS/MARKET
Large scale solar heating and air conditioning in the United States, 5:33524
SOLAR AIR CONDITIONING/INTERNATIONAL COOPERATION
Coordination/management tasks for the IEA and CCMS solar heating and cooling programs, 5:33462 (DOE/CS/30108—T2)
SOLAR AIR HEATERS/DESIGN
Development of an experimental test apparatus for natural convection solar collectors, 5:33519 (LA-UR—80-2329)
SOLAR AIR HEATERS/THERMOSYPHON EFFECT
Development of an experimental test apparatus for natural convection solar collectors, 5:33519 (LA-UR—80-2329)
SOLAR ARCHITECTURE
Passive solar design handbook. Volume one of two volumes. Passive solar design concepts, 5:33461 (DOE/CS—0127/1)
SOLAR ARCHITECTURE/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
SOLAR ARCHITECTURE/MANUALS
Passive solar house designs for New Mexico climates. Final report, July 1, 1978-January 31, 1980. Part 1: design manual, 5:33482 (NMEI—22)
SOLAR CELL ARRAYS
See also PHOTOVOLTAIC POWER SUPPLIES
SOLAR CELL ARRAYS/FABRICATION
Phase 2 of the array automated assembly task for the Low Cost Solar Array Project. Final report, October 1, 1978-October 30, 1979, 5:33403 (DOE/JPL/954873—8)
SOLAR CELL ARRAYS/FIELD TESTS
Snow-covering effects on the power output of solar photovoltaic arrays, 5:33443 (COO—4094-61)
SOLAR CELL ARRAYS/INSPECTION
Portable, X-Y translating, infrared microscope for remote inspection of photovoltaic solar arrays, 5:33402 (DOE/ET/20279—101)
SOLAR CELL ARRAYS/SNOW
Snow-covering effects on the power output of solar photovoltaic arrays, 5:33443 (COO—4094-61)
SOLAR CELLS
See also CADMIUM SULFIDE SOLAR CELLS
CONCENTRATOR SOLAR CELLS
SILICON SOLAR CELLS
SOLAR CELLS/GRADED BAND GAPS
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
SOLAR CELLS/MATERIALS
Advanced research and development on photovoltaic materials, 5:33395 (BNL—51118)
SOLAR CELLS/OCCUPATIONAL SAFETY
Industrial hygiene of photovoltaic cell production, 5:33401 (BNL—51118)
SOLAR CELLS/RESEARCH PROGRAMS
Overview of the national photovoltaic program, 5:33393 (BNL—51118)
Photovoltaic Research Branch semiannual report, 1 October 1979-31 March 1980, 5:33408 (SERI/PR—611-737)
SOLAR COLLECTORS
See also CONCENTRATING COLLECTORS
EVACUATED COLLECTORS
FLAT PLATE COLLECTORS
PARABOLIC DISH COLLECTORS
PARABOLIC TROUGH COLLECTORS
SOLAR AIR HEATERS
TOWER FOCUS COLLECTORS
SOLAR COLLECTORS/COMPARATIVE EVALUATIONS
Comparison of solar thermal energy collection using fixed and tracking collectors, 5:33532
SOLAR COLLECTORS/CORROSION
Review of state-of-the-art of solar collector corrosion processes. Task 1 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33517 (DOE/CS/10510—T12)
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
SOLAR COLLECTORS/MATERIALS
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
SOLAR COLLECTORS/MATERIALS TESTING
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
SOLAR COLLECTORS/PERFORMANCE
Model validation and sensitivity analysis of solar collector loops. Final technical report, 5:33518 (DOE/CS/30218—1)
SOLAR COLLECTORS/PERFORMANCE TESTING
Experimental verification of a standard test procedure for solar collectors, 5:33520 (NBS-BSS—117)
SOLAR COLLECTORS/SENSITIVITY ANALYSIS
Model validation and sensitivity analysis of solar collector loops. Final technical report, 5:33518 (DOE/CS/30218—1)
SOLAR COLLECTORS/SOLAR ACCESS
Site planning for solar access: a guidebook for residential developers and site planners, 5:33472 (HUD-PDR—481)
SOLAR COLLECTORS/TEST FACILITIES
Experimental verification of a standard test procedure for solar collectors, 5:33520 (NBS-BSS—117)
SOLAR COLLECTORS/THERMAL INSULATION
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)
SOLAR CONCENTRATORS
See also COMPOUND PARABOLIC CONCENTRATORS
FRESNEL LENS
MIRRORS
SOLAR REFLECTORS
SOLAR CONCENTRATORS/DESIGN
System designs fr low cost-low ratio solar concentrators, 5:33528
SOLAR CONCENTRATORS/FRESNEL LENS
Linear echelon refractor/reflector solar concentrators, 5:33529
SOLAR COOLING SYSTEMS
See also PASSIVE SOLAR COOLING SYSTEMS
SOLAR AIR CONDITIONERS
SOLAR COOLING SYSTEMS/DEMONSTRATION PROGRAMS
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
Operational experiences from the federal solar heating and cooling demonstrations, 5:33473 (IS-M—286)
SOLAR COOLING SYSTEMS/ECONOMIC ANALYSIS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
SOLAR COOLING SYSTEMS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
SOLAR DISTILLATION/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
SOLAR DRYERS
Solar tobacco drying plant, 5:33506
SOLAR ENERGY/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
SOLAR ENERGY/ECONOMICS
Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies, 5:33385 (NP—24996)

SOLAR ENERGY/FINANCIAL INCENTIVES
Program listing for solar finance (SOLFIN): a computer code for the economic evaluation of residential and nonresidential applications of solar technologies, 5:33385 (NP—24996)
Regulations for the California Solar Energy Tax Credit, 5:33388 (P—500-79-016)
SOLAR ENERGY/GOVERNMENT POLICIES
Summary of the DPR, 5:33392 (SERI/TR—733-394)
SOLAR ENERGY/MEETINGS
Optics applied to solar energy IV. Volume 161, 5:33526
Solar energy for industry, 5:33490
SOLAR ENERGY/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
SOLAR ENERGY/PUBLIC POLICY
Social values and solar energy policy: the policy maker and the advocate, 5:33390 (SERI/RR—722-329R)
SOLAR ENERGY CONVERSION/HYDROGEN PRODUCTION
Solar/hydrogen systems technologies. Volume II (Part 2 of 2). Solar/hydrogen systems assessment. Final report, 5:33351 (DOE/JPL—955492(Vol.2)(Pt.2))
Solar/hydrogen systems technologies. Volume II (Part 1 of 2). Solar/hydrogen systems assessment. Final report, 5:33350 (DOE/JPL—955492(Vol.2)(Pt.1))
Solar/hydrogen systems for the 1985 to 2000 time frame. Volume I. Solar/hydrogen systems assessment. Final report, 5:33353 (DOE/JPL—955492(Vol.1))
SOLAR ENERGY CONVERSION/MEETINGS
Biological applications of solar energy, 5:33428
SOLAR EQUIPMENT
See also HELIOSTATS
PHOTOELECTROCHEMICAL CELLS
PHOTOVOLTAIC POWER SUPPLIES
PYRANOMETERS
SOLAR ABSORBERS
SOLAR CELL ARRAYS
SOLAR CELLS
SOLAR COLLECTORS
SOLAR CONCENTRATORS
SOLAR COOLING SYSTEMS
SOLAR DRYERS
SOLAR FURNACES
SOLAR HEATING SYSTEMS
SOLAR WATER HEATERS
SOLAR WATER PUMPS
SPECTRALLY SELECTIVE SURFACES
SOLAR EQUIPMENT/FINANCIAL INCENTIVES
Regulations for the California Solar Energy Tax Credit, 5:33388 (P—500-79-016)
SOLAR EQUIPMENT/MATERIALS
Polymers in solar technologies: an R and D strategy, 5:33521 (SERI/TR—334-601)
SOLAR FURNACES/OPTICS
Analysis of a Cassegrain solar furnace, 5:33511
SOLAR HEAT ENGINES/RESEARCH PROGRAMS
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
SOLAR HEATING SYSTEMS
See also PASSIVE SOLAR HEATING SYSTEMS
SOLAR-ASSISTED HEAT PUMPS
Solar systems for heating and cooling, 5:33489
SOLAR HEATING SYSTEMS/DEMONSTRATION PROGRAMS
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
Operational experiences from the federal solar heating and cooling demonstrations, 5:33473 (IS-M—286)
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar project description for Design Construction Association single family dwelling, Big Fork, Montana, 5:33488 (SOLAR/1029—80/50)
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
Solar project description for Moulder Corporation single family residence, Greenwood, Indiana, 5:33485 (SOLAR/1001—80/50)
Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland, 5:33486 (SOLAR/1012—80/50)
SOLAR HEATING SYSTEMS/DESIGN
Solar space heating for the visitors' center, Stephens College, Columbia, Missouri. Final report, 5:33467 (DOE/NASA/CR—161485)
SOLAR HEATING SYSTEMS/ECONOMIC ANALYSIS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
SOLAR HEATING SYSTEMS/HEAT TRANSFER FLUIDS
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOLAR HEATING SYSTEMS/INSTALLATION
Solar space heating for the visitors' center, Stephens College, Columbia, Missouri. Final report, 5:33467 (DOE/NASA/CR—161485)
SOLAR HEATING SYSTEMS/MARKET
Large scale solar heating and air conditioning in the United States, 5:33524
SOLAR HEATING SYSTEMS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
SOLAR HEATING SYSTEMS/OPERATION
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
SOLAR HEATING SYSTEMS/ORGANIC COOLANTS
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOLAR HEATING SYSTEMS/PERFORMANCE
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia, 5:33469 (DOE/NASA/CR—161507)
Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi, 5:33470 (DOE/NASA/CR—161509)
SOLAR INDUSTRY/INDUSTRIAL MEDICINE
Industrial toxicology, 5:34214 (BNL—51118)
SOLAR POWER PLANTS
See also OCEAN THERMAL POWER PLANTS
ORBITAL SOLAR POWER PLANTS
PHOTOVOLTAIC POWER PLANTS
SOLAR THERMAL POWER PLANTS
SOLAR POWER PLANTS/HEAT TRANSFER FLUIDS
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOLAR POWER PLANTS/ORGANIC COOLANTS
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOLAR PROCESS HEAT
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System, 5:33500 (DOE/SF/10737—1(Exect.Summ.))
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report, 5:33499 (DOE/SF/10737—1)
SOLAR PROCESS HEAT/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
SOLAR PROCESS HEAT/ECONOMICS
Analysis of the economic potential of solar thermal energy to provide industrial process heat in the United States, 5:33507
US Government appraisal of the potential of solar energy for industry, 5:33508
SOLAR PROCESS HEAT/MARKETING RESEARCH
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
SOLAR PROCESS HEAT/MEETINGS
Solar energy for industry, 5:33490
SOLAR PROCESS HEAT/RESEARCH PROGRAMS
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
SOLAR PROCESS HEAT/TEST FACILITIES
SERAPH facility capabilities, 5:33504 (SERI/RR—632-702)
SOLAR RADIATION/ATTENUATION
Experimental atmospheric extinction measurements at nine wavelengths between 0.3 and 10 μm, 5:33383

SOLAR RADIATION/CALCULATION METHODS
Solar index prediction methodology preliminary analysis, 5:33384 (DOE/ET/20090—4)
SOLAR REFLECTORS
See also PARABOLIC REFLECTORS
SOLAR REFLECTORS/LIGHT SCATTERING
Specularity measurements for solar materials, 5:33538
SOLAR REFLECTORS/OPTICAL PROPERTIES
Specularity measurements for solar materials, 5:33538
SOLAR RIGHTS/PLANNING
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
SOLAR RIGHTS/REGULATIONS
Solar envelope zoning: application to the city planning process. Los Angeles case study, 5:33391 (SERI/SP—98156-1)
SOLAR SPACE HEATING/INTERNATIONAL COOPERATION
Coordination/management tasks for the IEA and CCMS solar heating and cooling programs, 5:33462 (DOE/CS/30108—T2)
SOLAR THERMAL POWER PLANTS/ANNUAL ENERGY STORAGE
Value of seasonal storage of solar energy, 5:33543 (DOE/JPL—1060-12(Vol.2))
SOLAR THERMAL POWER PLANTS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
SOLAR THERMAL POWER PLANTS/ENERGY STORAGE
Survey of needs for energy storage in a solar thermal electric power plant, 5:33448 (DOE/JPL—1060-12(Vol.2))
Value of energy storage for direct-replacement solar thermal power plants, 5:33451 (DOE/JPL—1060-12(Vol.2))
SOLAR THERMAL POWER PLANTS/ENERGY STORAGE SYSTEMS
Electrochemical energy storage systems for solar thermal applications, 5:33453 (DOE/JPL—1060-38(Rev.1))
SOLAR THERMAL POWER PLANTS/HEAT STORAGE
Description of the solar thermal program, 5:33447 (DOE/JPL—1060-12(Vol.2))
Optimal dispatch of storage for solar plants in a conventional electric grid, 5:33450 (DOE/JPL—1060-12(Vol.2))
Systems analyses of storage in specific solar thermal power applications, 5:33542 (DOE/JPL—1060-12(Vol.2))
Thermal storage requirements criteria for solar power plants interfacing with utility systems, 5:33449 (DOE/JPL—1060-12(Vol.2))
SOLAR THERMAL POWER PLANTS/MARKETING RESEARCH
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
SOLAR THERMAL POWER PLANTS/RESEARCH PROGRAMS
Solar Thermal Power Systems Point-Focusing Thermal and Electric Applications Project. Annual technical report. Volume II. Detailed report, fiscal year 1979, 5:33452 (DOE/JPL—1060-31(Vol.2))
SOLAR THERMAL POWER PLANTS/THERMAL ENERGY STORAGE EQUIPMENT
Preliminary requirements for thermal storage subsystems in solar thermal applications, 5:33546 (SERI/RR—731-364)
SOLAR TRACKING/EQUIPMENT
Open-loop heliostat reflector, 5:33522 (UCID—18764)
SOLAR WATER HEATERS
Solar systems for heating and cooling, 5:33489
SOLAR WATER HEATERS/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33378 (TAC-STHC—79-004)
SOLAR WATER HEATERS/DEMONSTRATION PROGRAMS
National commercial solar heating and cooling demonstration: purposes, program activities, and implications for future programs, 5:33484 (SERI/RR—431-328)
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar project description for Design Construction Association single family dwelling, Big Fork, Montana, 5:33488 (SOLAR/1029—80/50)
Solar project description for the College Houses student co-op apartments, Austin, Texas, 5:33487 (SOLAR/1024—80/50)
Solar project description for Moulder Corporation single family residence, Greenwood, Indiana, 5:33485 (SOLAR/1001—80/50)
Solar project description for J.D. Evans, Inc. (House A) single family residence, Columbia, Maryland, 5:33486 (SOLAR/1012—80/50)
SOLAR WATER HEATERS/ECONOMIC ANALYSIS
Solar energy economics for the county of Santa Barbara, 5:33510 (NP—25017)
Solar energy system economic evaluation: final report for SEMCO-Loxahatchee, Loxahatchee National Wildlife Refuge, Palm Beach County, Florida, 5:33509 (DOE/NASA/CR—161512)
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
SOLAR WATER HEATERS/OPERATION
Solar hot water space heating system. Technical progress report, 5:33464 (DOE/CS/34412—16)
SOLAR WATER HEATERS/PERFORMANCE
Solar energy system performance evaluation. Seasonal report for Fern Lansing, Lansing, Michigan, 5:33468 (DOE/NASA/CR—161491)
Solar energy system performance evaluation: seasonal report for IBM System 3, Glendo, Wyoming, 5:33471 (DOE/NASA/CR—161520)
Solar energy system performance evaluation: seasonal report for Solaron-Duffield, Duffield, Virginia, 5:33469 (DOE/NASA/CR—161507)
Solar energy system performance evaluation: seasonal report for IBM System 4 at Clinton, Mississippi, 5:33470 (DOE/NASA/CR—161509)
SOLAR WATER PUMPS
Contribution of solar energy to the development of arid zones: experience of solar assisted mechanical and electrical systems for industrial and agricultural processes, 5:33454
SOLAR WATER PUMPS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
SOLAR-ASSISTED HEAT PUMPS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33460 (TAC-STC—79-004)
SOLID WASTES
See also AGRICULTURAL WASTES
MINERAL WASTES
WOOD WASTES
SOLID WASTES/ENVIRONMENTAL TRANSPORT
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
SOLID WASTES/LEACHING
Attenuation by soils of selected potential contaminants from coal conversion facilities: a literature review, 5:33226 (ORNL/TM—7249)
SOLID WASTES/RESOURCE POTENTIAL
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
SOLID WASTES/WASTE PRODUCT UTILIZATION
Utilization of coal associated minerals. Quarterly report No. 9, October 1-December 31, 1979, 5:33219 (DOE/ET/10533—9)
SOLIDS/EQUATIONS OF STATE
Cell-model prediction of the melting of a Lennard-Jones solid, 5:34374
SOLIDS/LENNARD-JONES POTENTIAL
Cell-model prediction of the melting of a Lennard-Jones solid, 5:34374
SOLIDS/MELTING
Cell-model prediction of the melting of a Lennard-Jones solid, 5:34374
SOLVENT-REFINING COAL PLANTS
See COAL PREPARATION PLANTS
SRC PROCESS
SOOT
Chemistry of combustion of fuel-water mixtures. Final technical report, 5:33941 (AD-A—076958)
SORGHUM/FERMENTATION
Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
SOUTH AFRICA/COAL INDUSTRY
Forty-ninth annual report of the Fuel Research Board including a report by the Chairman of the Coal Mining Research Controlling Council, 31 December 1979, 5:33172 (NP—25053)

SOUTH CAROLINA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
SOUTH DAKOTA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
SOUTHWEST REGION
See also ARKANSAS
LOUISIANA
NEW MEXICO
OKLAHOMA
TEXAS
SOUTHWEST REGION/INTERCONNECTED POWER SYSTEMS
Summary report of the analysis of expansion of the Pacific Northwest-Southwest intertie system, 5:33741 (P—500-80-019)
SOVIET UNION
See USSR
SOYBEAN OIL/CHEMICAL COMPOSITION
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOYBEAN OIL/PHYSICAL PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SOYBEAN OIL/THERMODYNAMIC PROPERTIES
Vegetable oils: liquid coolants for solar heating and cooling applications, 5:33459 (ALO—4298-2)
SPACE HEATING
See also ANNUAL CYCLE ENERGY SYSTEM
GEOTHERMAL SPACE HEATING
SOLAR SPACE HEATING
SPACE HEATING/ENERGY DEMAND
Annual heating and cooling requirements and design-day performance for a residential model in six climates: a comparison of NBSLD, BLAST 2, and DOE-2.1, 5:33779 (LBL—9270)
SPACE VEHICLES/COMMUNICATIONS
Study of a space communication system for the control and monitoring of the electric distribution system. Volume II. Supporting data and analyses, 5:33740 (JPL-PUB—80-48(Vol.2))
SPACE VEHICLES/REENTRY
Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
SPACE VEHICLES/SURFACES
Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
SPECTRALLY SELECTIVE SURFACES/MICROSTRUCTURE
Microstructural characterization of a black chrome solar selective absorber, 5:33536
SPECTRALLY SELECTIVE SURFACES/OPTICAL PROPERTIES
New instrumentation for high temperature and hemispherical measurements of selective surfaces, 5:33537
SPECTRALLY SELECTIVE SURFACES/PERFORMANCE TESTING
New instrumentation for high temperature and hemispherical measurements of selective surfaces, 5:33537
SPECTRALLY SELECTIVE SURFACES/REFLECTIVITY
Colored stainless steel: a new type of selective absorber, 5:33535
Microstructural characterization of a black chrome solar selective absorber, 5:33536
SPECTROSCOPY
See also LASER SPECTROSCOPY
SPECTROSCOPY/NONLINEAR PROBLEMS
Nonlinear spectroscopy by multiresonant four-wave mixing, 5:34384
SPENT FUEL STORAGE/FUEL ELEMENT FAILURE
Spent fuel resistance to internally produced cladding degradation, 5:33310 (HEDL-SA—2138)
SPENT FUELS/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)
SPENT FUELS/MATERIALS HANDLING
Spent fuel handling and packaging program. Quarterly report, April-June 1980, 5:33309 (DOE/NV/10061—3)
SPENT FUELS/PACKAGING
Spent fuel handling and packaging program. Quarterly report, April-June 1980, 5:33309 (DOE/NV/10061—3)
SPENT SHALES/MASS BALANCE
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
SPENT SHALES/QUANTITATIVE CHEMICAL ANALYSIS
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
SPENT SHALES/WASTE PRODUCT UTILIZATION
Potential uses of spent shale in the treatment of oil shale retort waters, 5:33299 (LBL—11072)
SPHERES/DEFECTS
Application of MOOT to scattering of elastic waves from compound inclusions, 5:34046 (LA-UR—80-2039)
SPHERES/SINTERING
Numerical methods for analyzing sintering by surface diffusion, 5:33913
SPHERES/ULTRASONIC TESTING
Application of MOOT to scattering of elastic waves from compound inclusions, 5:34046 (LA-UR—80-2039)
SPHERES (FUEL)
See FUEL SPHERES
SPIN GLASS STATE/MICROSTRUCTURE
Muon spin rotation and other microscopic probes of spin-glass dynamics, 5:34371 (LA-UR—80-2372)
SPINELS/PHOTOELECTRIC EFFECT
Photoelectric effects in magnesium aluminum spinel, 5:33910
SPRAY PONDS
See COOLING PONDS
SPRINGS (WATER)
See WATER SPRINGS
SQUID DEVICES/DESIGN
Optimization of SQUID differential magnetometers, 5:33974
SQUID digital electronics, 5:34014
SQUIDs for measuring the magnetic properties of materials, 5:33965
SQUID DEVICES/ELECTRIC IMPEDANCE
Analytic study on the influence of the weak link parameters on the resonant circuit of the nonhysteretic rf SQUID ($W \leqq 10^8 s^{-1}$), 5:33973
SQUID DEVICES/FABRICATION
Granular superconductors for SQUIDs, 5:34008
Present status and future of the dc SQUID, 5:33963
SQUID DEVICES/MARKET
Commercial superconducting SQUID systems, 5:33971
SQUID DEVICES/OPERATION
Development of a London moment readout for a superconducting gyroscope, 5:33976
Rf SQUIDs: the state of the science, 5:33962
SQUID DEVICES/PERFORMANCE
Application of a microwave biased rf-SQUID-system to investigate magnetic after-effects, 5:33975
Granular superconductors for SQUIDs, 5:34008
Present status and future of the dc SQUID, 5:33963
Rf SQUIDs: the state of the science, 5:33962
SQUID digital electronics, 5:34014
SQUID signal strength versus frequency - some surprises, 5:33972
SQUIDs and magnetotellurics with a remote reference, 5:33967
SQUIDs for measuring the magnetic properties of materials, 5:33965
Superconducting gravity gradiometers, 5:33978
Use of SQUIDs in low-frequency communication systems, 5:33970
SQUID DEVICES/REVIEWS
Future of superconducting instruments in metrology, 5:33979
SQUID DEVICES/SENSITIVITY
Development of a London moment readout for a superconducting gyroscope, 5:33976
Fluctuation analysis, 5:34381 (LBL—11055)
Signal detection in 1/f noise of SQUID magnetometers, 5:33977
Superconducting gravity gradiometers, 5:33978
SQUID DEVICES/SIGNALS
SQUID signal strength versus frequency - some surprises, 5:33972
SQUID DEVICES/USES
Application of SQUIDs to low temperature transport physics, 5:33964
Application of SQUIDs to measurements in fundamental physics, 5:33966
Application of a microwave biased rf-SQUID-system to investigate magnetic after-effects, 5:33975
Biomedical applications of SQUIDs, 5:33969
Measurements of magnetic gradients from ocean waves, 5:33968
Signal detection in 1/f noise of SQUID magnetometers, 5:33977
SRC PROCESS
Selectivity of coal minerals and SRC residue ashes for hydrodesulfurization in the SRC process, 5:33208
SRC PROCESS/PILOT PLANTS
Solvent refined coal (SRC) process operation of solvent refined coal pilot plant, Wilsonville, Alabama. Quarterly technical progress report, January-March 1979, 5:33201 (FE—2270-48)
SRC-II PROCESS/DEMONSTRATION PLANTS
Demonstration plant supplementary technical studies section 10-confidence analysis. SRC-II demonstration project, phase zero, task number 1, deliverable number 3, 5:33198 (DOE/ET/11328—T1)
STAINLESS STEEL-21-6-9/FRACTURE PROPERTIES
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)

STAINLESS STEEL-21-6-9/MICROSTRUCTURE
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
STAINLESS STEEL-304/MECHANICAL PROPERTIES
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-304/MICROSTRUCTURE
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-304/WELDED JOINTS
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-304L/COMPARATIVE EVALUATIONS
Prediction of the lifetime of canisters for solidified radioactive wastes, 5:33323 (DP-MS—80-47)
STAINLESS STEEL-304L/FRACTURE PROPERTIES
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
STAINLESS STEEL-304L/MICROSTRUCTURE
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
STAINLESS STEEL-308/MECHANICAL PROPERTIES
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-308/MICROSTRUCTURE
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-308/WELDED JOINTS
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
STAINLESS STEEL-316/CORROSION
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
STAINLESS STEEL-316/DECARBURIZATION
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
STAINLESS STEEL-316/FRACTURE PROPERTIES
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
STAINLESS STEEL-316/MICROSTRUCTURE
J-controlled crack growth as an indicator of hydrogen-stainless steel compatibility, 5:33861 (DP-MS—79-73)
STAINLESS STEEL-316/PHYSICAL RADIATION EFFECTS
Microstructure and tensile properties of T(d,n) and Be (d,n) neutron irradiated nickel, niobium and 316SS, 5:33895
Tensile properties of type 316 stainless steel irradiated in a simulated fusion reactor environment, 5:33894
STAINLESS STEEL-316/TENSILE PROPERTIES
Some aspects of materials development for sodium heated steam generators, 5:33862 (GEFR-SP—205)
STAINLESS STEEL-316/THERMODYNAMIC PROPERTIES
Measuring transient high temperature thermal phenomena in hostile environment, 5:33863 (PNL-SA—8295)
STAINLESS STEELS
STAINLESS STEEL-304
See also STAINLESS STEEL-304L
STAINLESS STEEL-308
STAINLESS STEEL-316
STAINLESS STEELS/CORROSION
Corrosion problems with aqueous coolants, final report, 5:33516 (DOE/CS/10510—T11)
Study of corrosion in multimetallic systems. Task 2 of solar collector studies for solar heating and cooling applications. Final technical progress report, 5:33514 (DOE/CS/10510—T9)
STAINLESS STEELS/MICROSTRUCTURE
Experimental method to determine the role of helium in neutron-induced microstructural evolution, 5:33893
STAINLESS STEELS/PHYSICAL RADIATION EFFECTS
Experimental method to determine the role of helium in neutron-induced microstructural evolution, 5:33893
STAINLESS STEELS/REFLECTIVITY
Colored stainless steel: a new type of selective absorber, 5:33535
STANDING CROP
See BIOMASS
STARFIRE TOKAMAK/HIGH-FREQUENCY HEATING
GRILL: a code to calculate the spectrum of lower-hybrid waves launched by a Brambilla waveguide array, 5:34393 (ANL/FPP/TM—135)
STARS
See also NEUTRON STARS
SUPERNOVAE
STARS/EQUATIONS OF STATE
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
STARS/GRAVITATIONAL COLLAPSE
Asymptotic freedom and dense baryonic matter, 5:34353
STATISTICAL MECHANICS/CORRELATION FUNCTIONS
Strong coupling expansion for classical statistical dynamics, 5:34389
STATISTICS
Remarks on the generalized Tukey's lambda family of distributions, 5:34442 (CONF-800820—6)
Some properties of the log-Laplace distribution, 5:34190 (ORNL/CSD/TM—68)
STEAM GENERATORS/RETROFITTING
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System, 5:33500 (DOE/SF/10737—1(Exect.Summ.))
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report, 5:33499 (DOE/SF/10737—1)
STEAM GENERATORS/TECHNOLOGY ASSESSMENT
Steam generators for industrial-scale power plants, 5:33796 (NP—24980)
STEELS
See also AUSTENITIC STEELS
CARBON STEELS
CHROMIUM STEELS
STAINLESS STEELS
STEELS/BIBLIOGRAPHIES
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
STEELS/CARBURIZATION
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
STEELS/CHEMICAL REACTIONS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
STEELS/FRACTURE PROPERTIES
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
STEELS/HYDROGEN EMBRITTLEMENT
Bibliography of hydrogen attack of steel and relevant ancillary topics, 5:33887 (IS—4747)
STIRLING ENGINES/DESIGN
Preliminary results from a four-working space, double-acting piston, Stirling engine controls model, 5:33822 (DOE/NASA/1040—17)
STIRLING ENGINES/PERFORMANCE
Preliminary results from a four-working space, double-acting piston, Stirling engine controls model, 5:33822 (DOE/NASA/1040—17)
STORAGE DEVICES (DATA)
See MEMORY DEVICES
STORAGE FACILITIES/DESIGN
Design of a maze structure to attenuate blast waves, 5:34105 (UCRL—52921)
STORAGE FACILITIES/SAFETY
Design of a maze structure to attenuate blast waves, 5:34105 (UCRL—52921)
STORAGE RINGS
See also CERN ISR
ISABELLE STORAGE RINGS
STORAGE RINGS/BEAM DYNAMICS
Tacoma mode, 5:34069 (BNL—27972)
STORAGE RINGS/BEAM INJECTION
Injection system for the Proton Storage Ring at LASL. Final report, 5:34078 (LA-UR—80-1945)
STORAGE RINGS/BEAM-BEAM INTERACTIONS
Recent experimental results on the beam-beam effects in storage rings and an attempt of their interpretation, 5:34075 (SLAC-PUB—2548)
STORAGE RINGS/SPECIFICATIONS
LASL high-current proton storage rings, 5:34086 (LA-UR—80-1946)
STORAGE (SPENT FUEL)
See SPENT FUEL STORAGE
STORMS/VARIATIONS
Further study of the variability in the frequency of typhoon formation over the West Pacific ocean, 5:34112 (COO—1340-75)
STOVER
See AGRICULTURAL WASTES
STRAIN GAGES/DESIGN
Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)

STRATEGIC PETROLEUM RESERVE/MANAGEMENT
Strategic petroleum reserve crude oil data search file documentation. Final report, June 1978-September 1979, 5:33278 (AD-A—076949)
STRATIFIED CHARGE ENGINES/FUEL SUBSTITUTION
Characterization of alcohol/gasoline blends as a stratified-charge engine fuel: performance and emissions, 5:33848 (CONF-790520—)
STREAMS/GEOCHEMISTRY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
STREAMS/HYDROLOGY
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
STRESS ANALYSIS/MEASURING INSTRUMENTS
Borehole-inclusion stressmeter measurements in bedded salt, 5:33331 (SAND—79-0377)
STRESSES
(Mechanics.)
STRESSES/MEASURING INSTRUMENTS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
STRESSES/MEASURING METHODS
Review of current capabilities for the measurement of stress, displacement, and in situ deformation modulus, 5:34226 (ONWI—95)
STRONG INTERACTIONS/PAULI PRINCIPLE
Elaboration of the recently proposed test of Pauli's principle under strong interactions, 5:34295
STRONG INTERACTIONS/RESEARCH PROGRAMS
Inelastic strong interactions at high energies. Annual progress report, June 1, 1978-May 31, 1979 (Univ. of Cincinnati), 5:34299 (COO—2978-4)
STRONTIUM/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
STRONTIUM 85/BIOLOGICAL HALF-LIFE
Improved methods for measuring radioactive tracer accumulation and excretion by microarthropods, with applications for a mite species, Tyrophagus longior (Acarina, Acaridae), 5:34171 (DOE/EV/00641—38)
STRONTIUM 88 TARGET/PROTON REACTIONS
Measurements of ^{88}Sr(p,n) to the ground state and low-lying excited states of ^{88}Y (5.75 to 11 MeV), 5:34329 (UCID—18577)
STRUCTURAL BUCKLING
See DEFORMATION
STRUCTURE (CRYSTAL)
See CRYSTAL STRUCTURE
SUBCRITICAL FLOW
See LAMINAR FLOW
SUBMARINES/RADIO EQUIPMENT
Use of SQUIDs in low-frequency communication systems, 5:33970
SUBSURFACE STRUCTURES/DESIGN
Nuclear waste repository in basalt project B-301 preconceptual design report, 5:33329 (RHO-BWI-CD—35)
SUGAR BEETS/FERMENTATION
Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
SUGAR CANE/FERMENTATION
Sugar-based fermentation for fuel alcohol, 5:33419 (CONF-7911103—1)
SULFATES/AEROSOL MONITORING
Development of a particulate sulfate analyzer. Final report, 5:34120 (EPRI-EA—1492)
SULFINOL PROCESS
Acid gas removal by versatile Shell processes, 5:33283
SULFONATES/EFFICIENCY
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)
SULFUR/SCAVENGING
Selectivity of coal minerals and SRC residue ashes for hydrodesulfurization in the SRC process, 5:33208
SULFUR 32 TARGET/NEUTRON REACTIONS
Non-statistical effects in neutron reactions on ^{32}S, 5:34324
SULFUR 32 TARGET/PION PLUS REACTIONS
Isospin quintets in the 1p and s-d shells, 5:34318
SULFUR 33/ENERGY LEVELS
Non-statistical effects in neutron reactions on ^{32}S, 5:34324
SULFUR DIOXIDE/CHEMICAL REACTIONS
Chemical Sciences Division, 5:33922 (BNL—50973)
SULFUR DIOXIDE/FORECASTING
Effects of a district-heating system on annual urban sulfur dioxide emissions, 5:33810 (CONF-790401—)
SULFUR DIOXIDE/POLLUTION ABATEMENT
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
SULFUR DIOXIDE/SOLVENT PROPERTIES
Removal of organic sulfur from coal: the use of liquid sulfur dioxide, 5:33179
SULFUR DIOXIDE/WASHOUT
Use of time averaged precipitation for wet removal in a regional air pollution assessment model, 5:34129 (PNL-SA—7658)
SULFUR HYDRIDES
See HYDROGEN SULFIDES
SULFUR ISOTOPES/ISOTOPE SEPARATION
The jet membrane process for uranium separation and enrichment. Final report on phase 2, 5:33305 (AD-A—076907)
SULFUR OXIDES
See also SULFUR DIOXIDE
SULFUR OXIDES/AIR POLLUTION ABATEMENT
Sulfur oxides control in catalytic cracking (Patent), 5:33272
SULFUR OXIDES/CHEMICAL REACTION YIELD
Sulfur oxides control in catalytic cracking (Patent), 5:33272
SULFUR OXIDES/EMISSION SPECTRA
Infrared multiphoton excitation and inverse electronic relaxation in SO_2, 5:34247
SULFUR OXIDES/FLUORESCENCE
Infrared multiphoton excitation and inverse electronic relaxation in SO_2, 5:34247
SULFUR OXIDES/POLLUTION ABATEMENT
Sulfur emission: control technology and waste management, 5:34119 (EPA/600/9—79-019)
SULFURIC ACID/CHEMICAL SPILLS
Sulfuric acid spills in marine accidents, 5:34161 (BNL—28123)
SUPER KUKLA REACTOR/CRITICALITY
Response of a fast neutron criticality monitor to prompt critical bursts, 5:34092
SUPERCONDUCTING CABLES/FABRICATION
LASL Nb_3Ge conductor development. Fifteenth quarterly progress report, January 1-March 31, 1980, 5:34379 (LA—8446-PR)
SUPERCONDUCTING CAVITY RESONATORS/PERFORMANCE
Superconducting resonators: high stability oscillators and applications to fundamental physics and metrology, 5:33982
SUPERCONDUCTING CAVITY RESONATORS/STABILITY
Superconducting resonators: high stability oscillators and applications to fundamental physics and metrology, 5:33982
SUPERCONDUCTING DEVICES
See also SQUID DEVICES
SUPERCONDUCTING CAVITY RESONATORS
SUPERCONDUCTING MAGNETS
SUPERCONDUCTING DEVICES/COOLING
Cryocoolers for superconductive electronics, 5:34011
Design and construction of microminiature cryogenic regrigerators, 5:34012
SUPERCONDUCTING DEVICES/DESIGN
Superconductive electronics in future computer designs, 5:34018
SUPERCONDUCTING DEVICES/FABRICATION
High resolution electron beam lithography and applications to superconducting devices, 5:33993
Improved materials for superconducting electronics, 5:34007
SUPERCONDUCTING DEVICES/FREQUENCY CONTROL
Superconducting microstrip filters, 5:33984
SUPERCONDUCTING DEVICES/MATERIALS
Improved materials for superconducting electronics, 5:34007
SUPERCONDUCTING DEVICES/MEETINGS
Future trends in superconductive electronics, (Charlottesville, 1978), 5:33961
SUPERCONDUCTING DEVICES/PERFORMANCE
Millimeter wave superconducting devices, 5:33985
SUPERCONDUCTING DEVICES/RESEARCH PROGRAMS
Superconductor-semiconductor device research, 5:34004
SUPERCONDUCTING DEVICES/USES
Superconducting microstrip filters, 5:33984
SUPERCONDUCTING JUNCTIONS
See also JOSEPHSON JUNCTIONS
SUPERCONDUCTING JUNCTIONS/PROXIMITY EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
SUPERCONDUCTING JUNCTIONS/TUNNEL EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
SUPERCONDUCTING MAGNETS/VACUUM SYSTEMS
ISABELLE vacuum systems, 5:34079 (BNL—27767)
SUPERCONDUCTIVITY
Experimental studies in solid state and low temperature physics. Final report for 1966-1980, 5:34378 (DOE/ER/01569—147)
SUPERCONDUCTORS
See also TYPE-II SUPERCONDUCTORS

SUPERCONDUCTORS/FABRICATION
A15 multifilamentary superconductors by the infiltration process, 5:34380 (LBL—10761)
Metallurgy and Materials Science Division, 5:34376 (BNL—50973)
SUPERCONDUCTORS/MECHANICAL PROPERTIES
Improved materials for superconducting electronics, 5:34007
SUPERCONDUCTORS/ORDER PARAMETERS
Effects of spin-flip scattering on the dynamics of the superconducting order parameter, 5:34375 (DOE/ER/01569—149)
SUPERCONDUCTORS/RESEARCH PROGRAMS
Metallurgy and Materials Science Division, 5:34376 (BNL—50973)
SUPERCRITICAL FLOW
See TURBULENT FLOW
SUPERHEAVY ELEMENTS
See TRANS 104 ELEMENTS
SUPERHETERODYNE RECEIVERS
See HETERODYNE RECEIVERS
SUPERNOVAE/CHEMICAL COMPOSITION
^{56}Ni and the light curve of Type I supernova, 5:34233 (LA-UR—80-2197)
SUPERNOVAE/LUMINOSITY
Luminosity of type I supernovae, 5:34235
SUPERNOVAE/NUCLEAR REACTIONS
Luminosity of type I supernovae, 5:34235
SUPERNOVAE/ORIGIN
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
SURFACE AIR
See also EARTH ATMOSPHERE
SURFACE AIR/RADIOACTIVITY
Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
SURFACE MINING
See also OIL SHALE MINING
SURFACE MINING/ENVIRONMENTAL EFFECTS
Environmental control technology survey of selected US strip mining sites. Volume 2B. Alabama. Water quality impacts and overburden chemistry of Alabama study site, 5:33224 (ANL/EMR—2(Vol.2B))
SURFACE MINING/MINING EQUIPMENT
Development of optimal terrace pit coal mining systems. Technical progress report, April 1980. Report No. TPR-80-4, 5:33231 (DOE/ET/10023—T6)
SURFACE MINING/OPTIMIZATION
Development of optimal terrace pit coal mining systems. Technical progress report, April 1980. Report No. TPR-80-4, 5:33231 (DOE/ET/10023—T6)
SURFACE MINING/PRODUCTIVITY
Coal mine labor productivity: mine-level data from Pike County, Kentucky, and other selected counties (1976 and 1977), 5:33232 (ORAU—168)
SURFACE PROPERTIES/MEASURING INSTRUMENTS
Normal emission photoelectron diffraction: a new technique for determining surface structure, 5:34099 (LBL—11017)
SURFACE WATERS
See also SEAS
STREAMS
SWIMMING POOLS
SURFACE WATERS/RADIOACTIVITY
Annual environmental monitoring report of the Lawrence Berkeley Laboratory, 1979, 5:34138 (LBL—11192)
SURFACE WATERS/RADIONUCLIDE MIGRATION
Low level waste management: a compilation of models and monitoring techniques. Volume 1, 5:33326 (ORNL/Sub—79/13617/2)
SURFACE WATERS/TEMPERATURE DISTRIBUTION
Cross-spectral study of the spatial relationships in the North Pacific sea-surface temperature anomaly field. Report No. 23, 5:34157 (COO—1340-68(Draft))
SURFACES
See also SPECTRALLY SELECTIVE SURFACES
SURFACES/HEAT TRANSFER
Application of ultrasonics to space shuttle tiles, 5:33952 (SAND—80-1380C)
SWAMPS/LAND USE
Wetland energy crops, 5:33433
SWEDEN/CO-GENERATION
European district-heating experience with focus on Uppsala hot-water district-heating system, 5:33804 (CONF-790401—)
SWEDEN/DISTRICT HEATING
European district-heating experience with focus on Uppsala hot-water district-heating system, 5:33804 (CONF-790401—)
SWIMMING POOLS/SOLAR WATER HEATING
Solar energy economics for the county of Santa Barbara, 5:33510 (NP—25017)
SYNTHESIS GAS/METHANATION
Deactivation by carbon of nickel and nickel-molybdenum methanation catalysts, 5:33190
SYNTHESIS GAS/PRODUCTION
Diacritic cracking of hydrocarbon feeds for selective production of ethylene and synthesis gas (Patent), 5:33356
SYNTHETASES
See LIGASES
SYNTHETIC FUELS
See also ALCOHOL FUELS
SYNTHETIC FUELS/COMMERCIALIZATION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
SYNTHETIC FUELS INDUSTRY/PLANNING
Values in conflict: design considerations for a two-stage synfuels development strategy, 5:33708 (RAND/N—1469-DOE)
SYNTHETIC FUELS INDUSTRY/SITE SELECTION
Values in conflict: design considerations for a two-stage synfuels development strategy, 5:33708 (RAND/N—1469-DOE)
SYNTHETIC FUELS INDUSTRY/TECHNOLOGY ASSESSMENT
Modeling approaches to long-run integrated technological impact analysis, 5:33664 (BNL—51126)

T

TANTALUM 181/ELECTRON REACTIONS
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
TANTALUM ALLOYS/ELECTRIC CONDUCTIVITY
Resistivity due to hydrogen in transition metal alloys, 5:33882
TANTALUM SELENIDES/PLASMA WAVES
Confirmation of McMillan's concept of "discommensurations", 5:33875
TAR SANDS
See OIL SANDS
TAXES/SOCIAL IMPACT
Energy taxation: an analysis of selected taxes, 5:33672 (DOE/EI/10553—T1)
TECHNETIUM/CHEMISTRY
Chemistry of technetium in the environment, 5:33930 (PNL—2579)
TECHNETIUM/ENVIRONMENTAL EXPOSURE PATHWAY
Chemistry of technetium in the environment, 5:33930 (PNL—2579)
TECHNOLOGY UTILIZATION
See also COMMERCIALIZATION
TECHNOLOGY UTILIZATION/PUBLIC OPINION
Technology: today's blue chip, 5:33688 (CONF-800212—)
TECHNOLOGY UTILIZATION/PUBLIC POLICY
Technology: today's blue chip, 5:33688 (CONF-800212—)
TECHNOLOGY UTILIZATION/RISK ASSESSMENT
Public reaction to imposed risk, 5:33681 (UCRL—84839)
TELLURIUM/TOXICITY
Toxicology of elements in dopants used in photovoltaic cells, 5:34210 (BNL—51118)
TEMPERATURE (AMBIENT)
See AMBIENT TEMPERATURE
TENNESSEE/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
TERBIUM 146/BETA-PLUS DECAY
Decay of ^{146}Tb and the lowest 2^+ state in ^{146}Gd, 5:34332
TERBIUM 159/ELECTRON REACTIONS
Current densities in the projected Hartree-Fock approach. II. Transverse form factors, 5:34351
TERRESTRIAL ECOSYSTEMS/MATHEMATICAL MODELS
Verification, validation, and application of detailed forest succession models, 5:34145 (DOE/TIC—11249)
TEST FACILITIES/DESIGN
Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities, 5:33949 (SAND—80-0481)
TEST FACILITIES/OPERATION
Sandia National Laboratories 8.8 metre (29-foot) and 10.7-metre (35-foot) centrifuge facilities, 5:33949 (SAND—80-0481)
TEST FACILITIES/REACTOR INSTRUMENTATION
Instrumentation needs in LWR severe fuel damage experiments, 5:33632 (CONF-800747—4)
TEXAS/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))

TEXAS/MAGNETIC SURVEYS
Aerial radiometric and magnetic survey: San Antonio National Topographic Map, Texas. Final report, 5:33302 (GJBX—160(80))
TEXAS/RADIOMETRIC SURVEYS
Aerial radiometric and magnetic survey: San Antonio National Topographic Map, Texas. Final report, 5:33302 (GJBX—160(80))
THERMAL CONDUCTION
(Heat transfer by conduction.)
THERMAL CONDUCTION/MEASURING METHODS
Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
THERMAL EFFLUENTS/TEMPERATURE EFFECTS
Productivity and species composition of algal mat communities exposed to a fluctuating thermal regime, 5:34194 (DP-MS—80-37)
THERMAL ENERGY STORAGE EQUIPMENT/COMPARATIVE EVALUATIONS
Preliminary requirements for thermal storage subsystems in solar thermal applications, 5:33546 (SERI/RR—731-364)
THERMAL ENERGY STORAGE EQUIPMENT/ECONOMIC ANALYSIS
Thermal storage cost/temperature tradeoffs for Solar Total Energy Systems (STES), 5:33456 (DOE/JPL—1060-12(Vol.2))
THERMAL ENERGY STORAGE EQUIPMENT/OPTIMIZATION
Systems analyses of storage in specific solar thermal power applications, 5:33542 (DOE/JPL—1060-12(Vol.2))
THERMAL ENERGY STORAGE EQUIPMENT/RESEARCH PROGRAMS
High temperature storage technologies for solar thermal applications, 5:33541 (DOE/JPL—1060-12(Vol.2))
THERMAL ENERGY STORAGE EQUIPMENT/SYSTEMS ANALYSIS
Preliminary requirements for thermal storage subsystems in solar thermal applications, 5:33546 (SERI/RR—731-364)
THERMAL INSULATION/EVALUATION
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)
THERMAL INSULATION/INSTALLATION
Massachusetts study of the retrofit insulation industry, 5:33771
THERMAL INSULATION/MATERIALS
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)
THERMAL INSULATION/REGULATIONS
Massachusetts study of the retrofit insulation industry, 5:33771
THERMAL INSULATION/SURVEYS
Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems, 5:33465 (DOE/CS/35363—T1)
THERMAL POLLUTION
(Environmental temperature rise due to waste heat disposal)
THERMAL POLLUTION/BIBLIOGRAPHIES
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
THERMAL POLLUTION/ENVIRONMENTAL EFFECTS
Evaluation of a cooling-lake fishery. Volume 1. Introduction, water quality, and summary. Final report, 5:34195 (EPRI-EA—1148(Vol.1))
THERMAL POWER PLANTS
See also FOSSIL-FUEL POWER PLANTS
GEOTHERMAL POWER PLANTS
NUCLEAR POWER PLANTS
REFUSE-FUELED POWER PLANTS
THERMAL POWER PLANTS/CLOSED-CYCLE COOLING SYSTEMS
Atmospheric and terrestrial effects of closed-cycle cooling systems: an annotated bibliography, 5:33596 (EPRI-EA—1438)
THERMAL POWER PLANTS/CO-GENERATION
Energy sources for a Twin Cities hot-water district-heating system, 5:33809 (CONF-790401—)
THERMAL POWER PLANTS/COOLING TOWERS
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
THERMAL POWER PLANTS/RETROFITTING
Hot-water district-heating in Minnesota cities, 5:33812 (CONF-790401—)
THERMAL POWER PLANTS/STEAM GENERATORS
Steam generators for industrial-scale power plants, 5:33796 (NP—24980)
THERMAL POWER PLANTS/WATER REQUIREMENTS
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
THERMAL STORAGE
See HEAT STORAGE
THERMAL WATERS/CHEMICAL COMPOSITION
Geochemistry of sericite and chlorite in well 14-2 Roosevelt Hot Springs geothermal system and in mineralized hydrothermal systems, 5:33559 (DOE/ET/28392—43)
THERMAL WATERS/GEOTHERMOMETRY
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
THERMAL WATERS/ISOTOPE RATIO
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
THERMAL WATERS/USES
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
Production and distribution of organisms in geothermal aquaculture: panel discussion, 5:33580 (ORESU-W—78-001)
THERMIONIC CONVERSION/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
THERMIONIC CONVERTERS/PROCESS HEAT
Optimal thermionic energy conversion with established electrodes for high-temperature topping and process heating, 5:33747 (DOE/NASA/1062—6)
THERMIONIC CONVERTERS/TOPPING CYCLES
Optimal thermionic energy conversion with established electrodes for high-temperature topping and process heating, 5:33747 (DOE/NASA/1062—6)
THERMOCHEMICAL HEAT STORAGE
Description of the thermal and thermochemical energy storage program, 5:33642 (DOE/JPL—1060-12(Vol.2))
THERMOELECTRIC CONVERSION/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
THERMOMETERS/SQUID DEVICES
Future of superconducting instruments in metrology, 5:33979
THERMONUCLEAR FUELS/FABRICATION
Process for manufacture of inertial confinement fusion targets and resulting product (Patent), 5:33345
THERMONUCLEAR FUELS/FUSION YIELD
Fuel temperature determination for ICF microspheres, 5:34422 (LA—8469-MS)
THERMONUCLEAR REACTORS
(For use in cases where certain aspects of either hypothetical or real thermonuclear reactors are discussed.)
See also DOUBLET REACTORS
LASER FUSION REACTORS
MAGNETIC MIRROR TYPE REACTORS
THERMONUCLEAR REACTORS/ENVIRONMENTAL IMPACTS
Fusion Reactor Safety Research Program annual report, FY-79, 5:34420 (EGG—2018)
THERMONUCLEAR REACTORS/HAZARDS
Fusion Reactor Safety Research Program annual report, FY-79, 5:34420 (EGG—2018)
THERMONUCLEAR REACTORS/SAFETY
Fusion Reactor Safety Research Program annual report, FY-79, 5:34420 (EGG—2018)
THIO COMPOUNDS
See ORGANIC SULFUR COMPOUNDS
THIOUREA/TOXICITY
Toxicology of phosphorus, thiourea, and other chemicals, 5:34211 (BNL—51118)
THORIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
THORIUM/ENVIRONMENTAL TRANSPORT
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
THORIUM/ISOTOPE RATIO
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
THORIUM 230/RADIOECOLOGICAL CONCENTRATION
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
THORIUM 232/RADIOECOLOGICAL CONCENTRATION
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)

THORIUM CARBIDES/DISSOLUTION
Dissolution of HTGR TRISO beads by the alkali fluoride fusion method, 5:33308 (NBL—296)
THORIUM OXIDES/CHEMICAL PREPARATION
Preparation of thorium-uranium gel spheres, 5:33307 (CONF-800802—12)
THREE MILE ISLAND-2 REACTOR/DECONTAMINATION
Three Mile Island: then and now, 5:33633 (DOE/TIC—11235)
THREE MILE ISLAND-2 REACTOR/REACTOR ACCIDENTS
Three Mile Island: then and now, 5:33633 (DOE/TIC—11235)
THREE-BODY PROBLEM/BINDING ENERGY
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
TIME-OF-SEASON PRICING
See TIME-OF-USE PRICING
TIME-OF-USE PRICING/RATE STRUCTURE
Electric Utility Rate Design Study: embedded generation costs on a time-of-day basis for Iowa Southern Utilities Company, 5:33726
TIN/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33259
TIN/MONITORING
Health hazard evaluation determination. Appendix, 5:34115 (BNL—51118)
TIN 116 TARGET/ARGON 40 REACTIONS
Light-charged-particle emission in ^{40}Ar-induced reactions: A probe of the very early evolution of the collisions, 5:34336
TIN ALLOYS/ANTIFERROMAGNETISM
Observation of an unusual magnetic phase transition in $NdSn_3$, 5:33873
TIN ALLOYS/CORROSION PROTECTION
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
TIN ALLOYS/MAGNETIC SUSCEPTIBILITY
Observation of an unusual magnetic phase transition in $NdSn_3$, 5:33873
TIN ALLOYS/PROXIMITY EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
TIN ALLOYS/TUNNEL EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
TITANATES/DOMAIN STRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
TITANATES/MICROSTRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
TITANIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
TITANIUM/CORROSION RESISTANCE
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
TITANIUM/ELECTROPLATING
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
TITANIUM/SURFACE PROPERTIES
Plating on difficult-to-plate metals: what's new, 5:33871 (UCRL—84440)
TITANIUM ALLOYS
See also TITANIUM BASE ALLOYS
TITANIUM ALLOYS/ELECTRIC CONDUCTIVITY
Resistivity due to hydrogen in transition metal alloys, 5:33882
TITANIUM ALLOYS/MECHANICAL PROPERTIES
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
TITANIUM ALLOYS/MICROSTRUCTURE
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1 1979-April 30, 1980, 5:33885 (DOE/ER/05246—4)
TITANIUM ALLOYS/PHYSICAL RADIATION EFFECTS
Irradiation creep studies of titanium alloys, 5:33899
TITANIUM ALLOYS/SORPTIVE PROPERTIES
Activation of FeTi for hydrogen absorption: an electron microscopic study, 5:33874
TITANIUM BASE ALLOYS/CORROSION PROTECTION
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
TITANIUM BASE ALLOYS/DEFORMATION
Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865
TITANIUM BASE ALLOYS/PHYSICAL RADIATION EFFECTS
Microstructure of single and dual-ion irradiated Fe-20Ni-15Cr and Ti-6Al-4V alloys, 5:33890
TITANIUM OXIDES/RECOVERY
Direct utilization: recovery of minerals from coal fly ash. Fossil Energy program. Technical progress report, 1 January-30 March 1980, 5:33221 (IS—4744)
TMX DEVICES/HIGH-FREQUENCY HEATING
Report of the workshop on rf heating in mirror systems, 5:34394 (DOE/ER—0070)
TOBACCO/SOLAR DRYING
Solar tobacco drying plant, 5:33506
TOKAMAK DEVICES
See also ALCATOR DEVICE
TOKAPOLE DEVICES
TOKAMAK DEVICES/CHARGED-PARTICLE TRANSPORT
Nonadiabatic effects of field ripple on energetic ions in tokamaks, 5:34401 (DOE/ET/53036—17)
TOKAMAK DEVICES/DIVERTORS
Divertor experiments in a toroidal plasma, with E x B drift due to an applied radial electric field, 5:34433 (COO—2387-117)
TOKAMAK DEVICES/ELECTRIC CURRENTS
Current generation by unidirectional lower hybrid waves in the ACT-1 toroidal device, 5:34412
TOKAMAK DEVICES/MAGNETIC FIELD RIPPLES
Nonadiabatic effects of field ripple on energetic ions in tokamaks, 5:34401 (DOE/ET/53036—17)
TOKAMAK DEVICES/PLASMA DIAGNOSTICS
Ion beam probe diagnostic system. Technical progress report, 1 January 1979-30 June 1980. RPDL report No. 80-17, 5:34397 (DOE/ET/53004—1)
TOKAMAK DEVICES/PLASMA HEATING
Methods of driving current by heating a toroidal plasma, 5:34395 (PPPL—1692)
TOKAMAK DEVICES/PLASMA WAVES
Current generation by unidirectional lower hybrid waves in the ACT-1 toroidal device, 5:34412
TOKAMAK DEVICES/POLOIDAL DIVERTORS
Poloidal divertor experiment with applied E vector x B vector/B^2 drift, 5:34434 (DOE/ET/53051—5)
Stability and heating of a poloidal divertor tokamak, 5:34435 (DOE/ET/53051—6)
TOKAMAK DEVICES/TRANSPORT THEORY
Alteration of Pfirsch—Schlueter transport in tokamaks by all four external sources, 5:34405
TOKAPOLE DEVICES/PLASMA INSTABILITY
Axisymmetric instability in a noncircular tokamak, 5:34408 (COO—2387-118)
TONGONAN GEOTHERMAL FIELD/GEOTHERMAL EXPLORATION
Tongonan geothermal field Leyte, Philippines. Report on exploration and development, 5:33556 (NP—24999)
TONGONAN GEOTHERMAL FIELD/GEOTHERMAL POWER PLANTS
Tongonan geothermal field Leyte, Philippines. Report on exploration and development, 5:33556 (NP—24999)
TOTAL ENERGY SYSTEMS
See also MIUS
TOTAL ENERGY SYSTEMS/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
TOTAL ENERGY SYSTEMS/SOLAR ENERGY
Thermal storage cost/temperature tradeoffs for Solar Total Energy Systems (STES), 5:33456 (DOE/JPL—1060-12(Vol.2))
TOTAL ENERGY SYSTEMS/THERMAL ENERGY STORAGE EQUIPMENT
Thermal storage cost/temperature tradeoffs for Solar Total Energy Systems (STES), 5:33456 (DOE/JPL—1060-12(Vol.2))
TOTAL-ABSORPTION SPECTROMETERS
See SHOWER COUNTERS
TOWER FOCUS COLLECTORS/DESIGN
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Executive summary. Final report, 5:33496 (DOE/SF/10736—1/1)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Technical report. Final report, 5:33497 (DOE/SF/10736—1/2)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Appendices. Final report, 5:33498 (DOE/SF/10736—1/3)
Solar industrial retrofit system for the Provident Energy Company refinery. Appendices to final report, September 28, 1979 to July 15, 1980, 5:33493 (DOE/SF/10606—1(App.))
Solar industrial retrofit system for the Provident Energy Company refinery. Sections 2-8. Final report, September 28, 1979 to July 15, 1980, 5:33492 (DOE/SF/10606—1/2)

Solar industrial retrofit system for the Provident Energy Company refinery. Section 1: executive summary. Final report, September 28, 1979-July 15, 1980, 5:33491 (DOE/SF/10606—1/1)
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System, 5:33500 (DOE/SF/10737—1(Exect.Summ.))
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report, 5:33499 (DOE/SF/10737—1)
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor uranium mill solar retrofit. Final technical report, 5:33494 (DOE/SF/10608—1)
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))

TOWER FOCUS COLLECTORS/RETROFITTING
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Executive summary. Final report, 5:33496 (DOE/SF/10736—1/1)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Technical report. Final report, 5:33497 (DOE/SF/10736—1/2)
Solar industrial retrofit system: North Coles Levee Natural Gas Processing Plant. Appendices. Final report, 5:33498 (DOE/SF/10736—1/3)
Solar industrial retrofit system for the Provident Energy Company refinery. Appendices to final report, September 28, 1979 to July 15, 1980, 5:33493 (DOE/SF/10606—1(App.))
Solar industrial retrofit system for the Provident Energy Company refinery. Sections 2-8. Final report, September 28, 1979 to July 15, 1980, 5:33492 (DOE/SF/10606—1/2)
Solar industrial retrofit system for the Provident Energy Company refinery. Section 1: executive summary. Final report, September 28, 1979-July 15, 1980, 5:33491 (DOE/SF/10606—1/1)
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System, 5:33500 (DOE/SF/10737—1(Exect.Summ.))
Solar Repowering/Industrial Retrofit Systems. Category B: Solar Thermal-Enhanced Oil Recovery System. Final report, 5:33499 (DOE/SF/10737—1)
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor uranium mill solar retrofit. Final technical report, 5:33494 (DOE/SF/10608—1)
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report, executive summary, 5:33495 (DOE/SF/10608—-(Exect. Summ.))
United States Gypsum Plant Solar Retrofit Program. Final report, 5:33502 (DOE/SF/10742—1(Vol.1))
United States Gypsum Plant Solar Retrofit Program, 5:33501 (DOE/SF/10742—1(Exec.Summ.))
United States Gypsum Plant Solar Retrofit Program. Volume 2. System requirements specification, 5:33503 (DOE/SF/10742—1(Vol.2))

TOXIC MATERIALS/SCREENING
Industrial toxicology, 5:34214 (BNL—51118)
Ranking methodology, 5:34197 (BNL—51118)

TRAINING
See EDUCATION

TRANS 104 ELEMENTS/CHEMICAL PROPERTIES
Search of new elements. Plans and perspectives, 5:34343

TRANS 104 ELEMENTS/NUCLEOSYNTHESIS
Search of new elements. Plans and perspectives, 5:34343

TRANSDUCERS/PERFORMANCE TESTING
Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology, 5:34048 (SAND—80-8733)

TRANSDUCERS/TEST FACILITIES
Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology, 5:34048 (SAND—80-8733)

TRANSFER (HEAT)
See HEAT TRANSFER

TRANSFER (MASS)
See MASS TRANSFER

TRANSFER RNA/BIOSYNTHESIS
Comprehensive progress report, 1977-1980, 5:34168 (DOE/EV/03083—T1)

TRANSITION ELEMENTS/CATALYTIC EFFECTS
Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191

TRANSMUTATION/FEASIBILITY STUDIES
Transmutation of radwaste using accelerators, 5:33321 (RHO-BSA—174)

TRANSPIRATION/COMPARATIVE EVALUATIONS
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)

TRANSPORT
(Limited to the movement of goods and persons.)
See also MARITIME TRANSPORT
PNEUMATIC TRANSPORT

TRANSPORT/RISK ASSESSMENT
Assessment of the risk of transporting propane by truck and train, 5:34218 (PNL-SA—8202)

TRANSPORT THEORY/PFIRSCH-SCHLUETER REGIME
Alteration of Pfirsch—Schlueter transport in tokamaks by all four external sources, 5:34405

TRANSPORTATION SECTOR/ENERGY CONSERVATION
Conservation of fuels in the St. Louis SMSA: projections from alternative residential land-use patterns and transportation strategies for 1995, 5:33691 (CUERS-Report—8)

TRANSPORTATION SECTOR/FUEL SUBSTITUTION
Alternative transportation fuels, 5:33849 (CONF-800419—5)

TRANSPORTATION SYSTEMS/COMPARATIVE EVALUATIONS
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234

TRANSPORTATION SYSTEMS/MATHEMATICAL MODELS
Economics of alternative coal transportation and distribution systems in Iowa. Special Report No. 81, 5:33234

TRANSURANIUM ELEMENTS
See also PLUTONIUM

TRANSURANIUM ELEMENTS/FLUIDIZED-BED COMBUSTION
Fluidized bed incineration process design for transuranic waste, 5:33320 (RFP—2945)

TRANSURANIUM ELEMENTS/INVENTORIES
Spent fuel and waste inventories and projections, 5:33314 (ORO—778)

TREES
See also PINES

TREES/HARVESTING
Strip selection method of mechanized thinning in northern hardwood pole size stands, 5:33437

TREES/MORTALITY
Fuels from woody biomass. First annual report, 3 April 1978-2 January 1979, 5:33422 (DOE/ET/20049—T1)

TREES/NUTRIENTS
Biomass, energy, and nutrient estimation of mixed southern hardwoods, 5:33435

TREES/SEEDLINGS
Fuels from Woody Biomass Program. Quarterly report, February 1 to June 1, 1980, 5:33423 (DOE/ET/20593—T1)

TREES/USES
Uses of tree legumes in semi-arid regions, 5:33420 (CONF-8006100—1)

TREES/VEGETATIVE PROPAGATION
Fuels from Woody Biomass Program. Quarterly report, February 1 to June 1, 1980, 5:33423 (DOE/ET/20593—T1)

TREES/YIELDS
Biomass, energy, and nutrient estimation of mixed southern hardwoods, 5:33435

TRI-GAS PROCESS/PROCESS DEVELOPMENT UNITS
Test and evaluate the TRI-GAS Low-Btu Coal Gasification Process. Quarterly report, April-June 1980, 5:33182 (DOE/ET/10254—82)

TRITIUM/DIFFUSION
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)

TRITIUM/ISOTOPE SEPARATION
Extraction method of tritium (Patent), 5:33933

TRITIUM/MATERIALS HANDLING
Tritium practices past and present, 5:34023 (UCRL—84318)

TRITIUM/SCINTILLATION COUNTING
Evaluation of oxidation techniques for preparing bioassay and environmental samples for liquid scintillation counting, 5:34153 (UCRL—52966)

TRITIUM TARGET/NEUTRON REACTIONS
Neutron total cross section for tritium (60 keV to 80 MeV), 5:34314 (UCID—18577)

TRITON BEAMS/ION SOURCES
Operating experience and cesium recycling on the LASL polarized triton source, 5:34076 (LA-UR—80-1905)

TRITON REACTIONS/ELASTIC SCATTERING
Polarized triton scattering from ^{26}Mg, ^{27}Al and ^{28}Si at 17 MeV, 5:34325 (LA-UR—80-1925)

TRITON REACTIONS/PICKUP REACTIONS
Single-proton states in ^{149}Pm (From ^{150}Sm(t,α) at 17 MeV), 5:34334
TRITON REACTIONS/STRIPPING
The (t,d) reaction on the Ni isotopes with polarized tritons, 5:34328 (LA-UR—80-1977)
TRITONS/BINDING ENERGY
Few-body binding energy correlations, 5:34311 (CONF-800829—6)
TROMBE WALLS/HEAT TRANSFER
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
TROMBE WALLS/SPECTRALLY SELECTIVE SURFACES
Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)
TROMBE WALLS/THERMAL INSULATION
Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)
TROPICAL REGIONS/CARBON CYCLE
Carbon Dioxide Effects Research and Assessment Program. The role of tropical forests on the world carbon cycle, 5:34148 (CONF-800350—)
TROUT/AQUACULTURE
Biology and husbandry of organisms in geothermal aquaculture: panel discussion, 5:33579 (ORESU-W—78-001)
TRUCKS/DIESEL ENGINES
Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
TRUCKS/FUEL SUBSTITUTION
Alternative transportation fuels, 5:33849 (CONF-800419—5)
TRUCKS/MARKET
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
TRUCKS/OPERATION
Fleet operator data book (summer 1977 data). Volume 1. National data, 5:33789 (BNL—50904)
TRUCKS/RANKINE CYCLE ENGINES
Status report on diesel organic Rankine compound engine for long-haul trucks, 5:33820 (TE—4257-207-80)
Status report on diesel organic-Rankine compound engine for long-haul trucks, 5:33819 (TE—4257-72-80)
TUBES (CONDUITS)
See PIPES
TUFF/FLUID MECHANICS
In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
TUFF/TEMPERATURE EFFECTS
In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
TUFF/THERMODYNAMIC PROPERTIES
In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
TUMORS
See NEOPLASMS
TUNGSTEN/CATALYTIC EFFECTS
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
TUNGSTEN/ELECTRON COLLISIONS
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
TUNGSTEN/SORPTIVE PROPERTIES
Structures of adsorbed CO on atomically smooth and on stepped sngle crystal surfaces, 5:33870 (SAND—80-1038C)
TUNGSTEN 170/ROTATIONAL STATES
Rotational energy expressions and least-squares fitting of backbenders and similar nuclei, 5:34338
TUNGSTEN ALLOYS/FABRICATION
Tungsten-rhenium composite tube fabricated by CVD for application in 1800°C high thermal efficiency fuel processing furnace, 5:33852 (HEDL-SA—2189)
TURBOJET ENGINES/EXHAUST GASES
Combustion diagnostics using laser spontaneous-Raman scattering. Final report, 1 July 1976-31 October 1978, 5:33940 (AD-A—076514)
TURBULENT FLOW/BOUNDARY LAYERS
Boundary layer behavior in transient turbulent thermal convection flow, 5:34040
TURNOVER (RADIONUCLIDES)
See RADIONUCLIDE KINETICS
TWO-BODY PROBLEM
Efimov pathology in effective two-body system, 5:34307 (CONF-800829—5)
TWO-BODY PROBLEM/SCATTERING
Few-body scattering integral equation approach, 5:34306 (CONF-800829—4)
TWO-PHASE FLOW/DENSITOMETERS
Gamma scattering, 5:34087 (CONF-800747—3)
TWO-PHASE FLOW/FUNCTIONAL MODELS
Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
TWO-PHASE FLOW/HEAT TRANSFER
Two-phase flow and heat transfer in fluidized beds. Final report, August 1, 1975-June 30, 1978, 5:34033 (EPRI-CS—1456)
TYPE-II SUPERCONDUCTORS/DEMAGNETIZATION
Demagnetization effects upon the lower critical field of an anisotropic type II superconductor of ellipsoidal shape, 5:34382
TYPE-II SUPERCONDUCTORS/TUNNEL EFFECT
Tunneling and the electron-phonon-coupled superconductivity of Nb_3Sn, 5:33872
TYPE-III SUPERCONDUCTORS
See TYPE-II SUPERCONDUCTORS
TZM
See ALLOY-TZM

U

U VALUES/MEASURING METHODS
Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
UCLBL
See LAWRENCE BERKELEY LABORATORY
UCLLL
See LAWRENCE LIVERMORE LABORATORY
UHV DC SYSTEMS/ELECTRICAL INSULATORS
Bipolar hvdc transmission system study: development of controlled cascade rectifier for insulator testing. Final report, 5:33609 (EPRI-EL—1496)
UJM
See JET MODEL
ULTRASONIC TESTING/CALIBRATION
Application of MOOT to scattering of elastic waves from compound inclusions, 5:34046 (LA-UR—80-2039)
ULTRASONIC TESTING/DATA ACQUISITION SYSTEMS
Generalized ultrasonic system for microcomputer controlled data collection, 5:34047 (LA-UR—80-2040)
ULTRASONIC TESTING/TRANSDUCERS
Transducer characterization techniques to enhance advanced ultrasonic nondestructive testing technology, 5:34048 (SAND—80-8733)
UNCORRELATED-JET MODEL
See JET MODEL
UNDERGROUND EXPLOSIONS
See also NUCLEAR EXPLOSIONS
UNDERGROUND EXPLOSIONS/BIBLIOGRAPHIES
Bibliography of reports by US Geological Survey personnel pertaining to underground nuclear testing and radioactive waste disposal at the Nevada Test Site, and radioactive waste disposal at the WIPP Site, New Mexico, January 1, 1979-December 31, 1979, 5:34108 (USGS-OFR—80-817)
UNDERGROUND MINING/PRODUCTIVITY
Coal mine labor productivity: mine-level data from Pike County, Kentucky, and other selected counties (1976 and 1977), 5:33232 (ORAU—168)
UNDERWATER VEHICLES
See SUBMARINES
UNITED KINGDOM/ENERGY CONSUMPTION
Potential for industrial use of solar energy in the United Kingdom, 5:33505
UNITED KINGDOM/SOLAR ENERGY
Potential for industrial use of solar energy in the United Kingdom, 5:33505
UNITED STATES OF AMERICA
See USA
UNIVERSE/DENSITY
Astrophysics perspectives on high-energy nucleus-nucleus collisions, 5:34234 (LBL—8957)
URANIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
URANIUM/UPTAKE
Microbial uptake of uranium, cesium, and radium, 5:33315 (CONF-800814—12)
URANIUM CARBIDES/DISSOLUTION
Dissolution of HTGR TRISO beads by the alkali fluoride fusion method, 5:33308 (NBL—296)
URANIUM DEPOSITS/AERIAL PROSPECTING
Aerial radiometric and magnetic survey: San Antonio National Topographic Map, Texas. Final report, 5:33302 (GJBX—160(80))

URANIUM DEPOSITS/ENVIRONMENTAL TRANSPORT
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
URANIUM DEPOSITS/EXPLORATION
Engineering report on the Great Divide Basin drilling project Sweetwater County, Wyoming, May 1980, 5:33301 (GJBX—124(80))
Pocatello 1° x 2° NTMS area Idaho. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance, 5:34165 (GJBX—161(80))
URANIUM DEPOSITS/ISOTOPE RATIO
Interim report on studies of uranium, thorium, and lead migration at Key Lake, Saskatchewan, Canada, 5:33300 (LA—8440-MS)
URANIUM DEPOSITS/PROSPECTING
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
Stream sediment detailed geochemical survey for Date Creek Basin, Arizona, 5:33304 (GJBX—164(80))
URANIUM DIOXIDE/CHEMICAL PREPARATION
Preparation of thorium-uranium gel spheres, 5:33307 (CONF-800802—12)
URANIUM DIOXIDE/PRODUCTION
Mixed oxide conversion facility alternative conceptual designs (Coprecipitation-direct calcination (COPRECAL)), 5:33306 (AGNS—35900-CONF-71)
URANIUM ISOTOPES/ISOTOPE SEPARATION
The jet membrane process for uranium separation and enrichment. Final report on phase 2, 5:33305 (AD-A—076907)
URANIUM MILLS
See FEED MATERIALS PLANTS
URANIUM OXIDES
See also URANIUM DIOXIDE
URANIUM OXIDES U3O8
URANIUM OXIDES/CATALYTIC EFFECTS
Hydrocarbon conversion with an acidic multimetallic catalytic composite (Patent), 5:33258
URANIUM OXIDES U3O8/DOMESTIC SUPPLIES
Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
URANIUM OXIDES U3O8/EXPORTS
Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
URANIUM OXIDES U3O8/IMPORTS
Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
URANIUM OXIDES U3O8/SUPPLY AND DEMAND
Survey of United States uranium marketing activity, 5:33311 (DOE/RA—0053)
URANYL COMPLEXES/LATTICE PARAMETERS
Imidazolium tetrachlorodioxouranate(VI), $[C_3N_2H_5^+]_2[UO_2Cl_4]^{2-}$, 5:33938
URANYL COMPLEXES/MOLECULAR STRUCTURE
Imidazolium tetrachlorodioxouranate(VI), $[C_3N_2H_5^+]_2[UO_2Cl_4]^{2-}$, 5:33938
URBAN AREAS/ENERGY DEMAND
Effects of atmospheric variability on energy utilization and conservation. Progress report, 5:34113 (COO—1340-76)
URBAN AREAS/MIUS
Application of Modular Integrated Utility Systems (MIUS) concept as a strategy for urban rehabilitation and redevelopment, 5:33813 (ORNL/HUD/MIUS—53)
US DOE
See also BNL
BONNEVILLE POWER ADMINISTRATION
ENERGY INFORMATION ADMINISTRATION
HANFORD RESERVATION
LASL
LAWRENCE BERKELEY LABORATORY
LAWRENCE LIVERMORE LABORATORY
SANDIA LABORATORIES
SAVANNAH RIVER PLANT
US DOE/MANAGEMENT
Business strategy groups lessons learned, 5:34439 (DOE/PR—0041)
US DOE/RESEARCH PROGRAMS
Summaries of physical research in the geosciences, 5:34219 (DOE/ER—0071)
USA
See also ALABAMA
ALASKA
ARIZONA
ARKANSAS
CALIFORNIA
COLORADO
CONNECTICUT
DELAWARE
FLORIDA
GEORGIA
HAWAII
IDAHO
ILLINOIS
INDIANA
IOWA
KANSAS
KENTUCKY
LOUISIANA
MAINE
MARYLAND
MASSACHUSETTS
MICHIGAN
MINNESOTA
MISSISSIPPI
MISSOURI
MONTANA
NEBRASKA
NEVADA
NEW HAMPSHIRE
NEW JERSEY
NEW MEXICO
NEW YORK
NORTH ATLANTIC REGION
NORTH CAROLINA
NORTH DAKOTA
OHIO
OKLAHOMA
OREGON
PACIFIC NORTHWEST REGION
PENNSYLVANIA
RHODE ISLAND
SOUTH CAROLINA
SOUTH DAKOTA
SOUTHWEST REGION
TENNESSEE
TEXAS
UTAH
VERMONT
VIRGINIA
WASHINGTON
WEST VIRGINIA
WISCONSIN
WYOMING
USA/COAL INDUSTRY
Labor outlook for the bituminous coal mining industry. Final report (Forecasting to 1990 and 2030), 5:33706 (EPRI-EA—1477)
USA/COAL RESERVES
Bituminous coal and lignite production and mine operations-1978, 5:33229 (DOE/EIA—0118(78))
USA/ELECTRIC POWER
Assessment of the effect of uncertainty on the adequacy of the electric-utility industry's expansion plans, 1983-1990, 5:33735 (EPRI-EA—1446)
Monthly comparisons of peak demands and energy for load, 1974 to 1978, 5:33731 (DOE/EIA—0010/3)
USA/ENERGY CONSUMPTION
Energy data report: annual energy balance, 1978, 5:33757 (DOE/EIA—0181)
USA/ENERGY DEMAND
Labor outlook for the bituminous coal mining industry. Final report (Forecasting to 1990 and 2030), 5:33706 (EPRI-EA—1477)
Projected annual resource requirements at the national and regional level for the Department of Commerce energy forecast, 1985 and 2000, 5:33700 (PB—80-126956)
USA/ENERGY FACILITIES
Projected annual resource requirements at the national and regional level for the Department of Commerce energy forecast, 1985 and 2000, 5:33700 (PB—80-126956)
USA/ENERGY SUPPLIES
Energy data report: annual energy balance, 1978, 5:33757 (DOE/EIA—0181)
Feasibility of financing domestic energy development during 1978-1984. Analysis report AR/EI/79-26, 5:33697 (DOE/EIA—0181/2)
International energy indicators, 5:33663 (DOE/IA—0010/2)
USA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))

National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
USA/LABOR
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
USA/MANPOWER
Labor Market Projections Model: updating census with current population survey data at Lawrence Berkeley Laboratory, 5:33674 (LBL—11350)
USA/TRADE
International energy indicators, 5:33663 (DOE/IA—0010/2)
USSR/PETROLEUM
International energy indicators, 5:33663 (DOE/IA—0010/2)
UTAH/GEOLOGY
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
UTAH/GEOTHERMAL EXPLORATION
Geothermal exploration program, Hill Air Force Base, Davis and Weber Counties, Utah, 5:33555 (DOE/ET/28392—42)
UTAH/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 2. Pacific Southwest region, 5:33370 (DOE/RA/11025—T1(Vol.2))
UTAH/MINERAL RESOURCES
Minerals in the economy of Utah, 5:33685
UTAH/MINERALOGY
Petrology, geochronology, and chemical evolution of the Twin Peaks Rhyolite Domes, Utah, 5:33553 (DOE/ID/12079—4)
UTILITIES
See ELECTRIC UTILITIES

V

VALVES/BELLOWS
Development of bellows for sodium valve in Japan (LMFBR), 5:33625 (JAPFNR—507)
VALVES/PERFORMANCE TESTING
Rockwell Coal Lock Hopper Valve: METC SOA Test Valve No. A-16. State-of-the-art Lock Hopper Valve Testing and Development Project. Summary test report, 5:33184 (DOE/METC/SP—80/8)
VANADIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
VANADIUM/PHYSICAL RADIATION EFFECTS
Effect of nickel and nitrogen on void formation in ion bombarded vanadium, 5:33897
VANADIUM/SELF-DIFFUSION
Surface self-diffusion of vanadium, 5:33867 (IS-T—925)
VANADIUM/SURFACES
Surface self-diffusion of vanadium, 5:33867 (IS-T—925)
VANADIUM ALLOYS
See also VANADIUM BASE ALLOYS
VANADIUM ALLOYS/CORROSION PROTECTION
Corrosion protection and galvanic corrosion prevention for 7075 Al and Ti-6Al-6V-2Sn alloys. Final report, 5:33884 (BDX—613-2396)
VANADIUM ALLOYS/DEFORMATION
Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865
VANADIUM ALLOYS/ELECTRIC CONDUCTIVITY
Resistivity due to hydrogen in transition metal alloys, 5:33882
VANADIUM ALLOYS/MECHANICAL PROPERTIES
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
VANADIUM ALLOYS/MICROSTRUCTURE
Effects of composition and heat treatments on the strength and ductility of Fe-Cr-Co alloys, 5:33853 (LBL—9941)
VANADIUM BASE ALLOYS/PHYSICAL RADIATION EFFECTS
Effect of nickel and nitrogen on void formation in ion bombarded vanadium, 5:33897
VANPOOLING/ENERGY CONSERVATION
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
VANPOOLING/ENVIRONMENTAL IMPACTS
Three-point program to reduce fuel consumption, traffic congestion, and air pollution. Status report, 5:33790
VAPOR CONDENSATION
Vapor/liquid interaction and entrainment in falling film evaporators, 5:34266
VAPORIZATION
See EVAPORATION
VEGETATION
See PLANTS
VENTILATION
Indoor air-quality measurements in energy-efficient residential buildings, 5:33778 (LBL—8894(Rev.))
VERMONT/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
VESSELS
See CONTAINERS
VESSELS (PRESSURE)
See PRESSURE VESSELS
VIBRATIONS (MECHANICAL)
See MECHANICAL VIBRATIONS
VIRGINIA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 5. Southeast region, 5:33373 (DOE/RA/11025—T1(Vol.5))
VOLCANIC GASES/CHEMICAL COMPOSITION
Characterization of the magmatic and fumarolic gases by their radioactive aerosols, 5:34230
VOLCANIC GASES/RADIOACTIVITY
Characterization of the magmatic and fumarolic gases by their radioactive aerosols, 5:34230
VOLCANIC REGIONS/RISK ASSESSMENT
Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
VOLCANIC ROCKS
See also RHYOLITES
VOLCANIC ROCKS/ISOTOPE DATING
Summary of potassium/argon age dating, 1979, 5:33551 (DOE/ET/28392—41)
VOLCANISM/PROBABILITY
Disruptive event analysis: volcanism and igneous intrusion, 5:34223 (PNL—2882)
VOLTAGE REGULATORS/OPERATION
Load conditions for a storage battery, three-phase voltage inverter and asynchronous traction motor during acceleration of an automobile at set intensity, 5:33823 (DOE-tr—228)
VOLTAIC CELLS
See ELECTRIC BATTERIES

W

WALLS
See also TROMBE WALLS
WATER WALLS
WALLS/HEAT TRANSFER
Determining heat fluxes from temperature measurements made in massive walls, 5:33476 (LA-UR—80-2231)
WALLS/TEMPERATURE MEASUREMENT
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
WALLS/THERMAL CONDUCTION
Measurement and analysis of in situ dynamic thermal performance of building envelopes using heat-flowmeter arrays, 5:33766 (LBL—9821)
WASHINGTON/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 1. Pacific Northwest region, 5:33369 (DOE/RA/11025—T1(Vol.1))
WASHINGTON/MINING
Directory of Washington mining operations, 1979, 5:33682
WASHINGTON/WOOD WASTES
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
WASTE HEAT/HEAT RECOVERY
Useful heat from waste heat, 5:33799 (NP—24997)
WASTE HEAT BOILERS/PERFORMANCE
New technological developments in processing solid waste to energy, 5:33815

WASTE PROCESSING PLANTS/DEMONSTRATION PROGRAMS
Energy Recovery from Waste and Biomass Project, 5:34062
WASTE PROCESSING PLANTS/SAFETY
Causes and alleviation of explosions in solid waste shredders, 5:34061
WASTE PRODUCT UTILIZATION/ECONOMICS
Power plant fly ash as a resource for alumina and cement, 5:33222 (IS-M—289)
WASTE WATER/MASS BALANCE
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
WASTE WATER/QUANTITATIVE CHEMICAL ANALYSIS
Partitioning of major, minor, and trace elements during simulated in-situ oil shale retorting, 5:33296 (LBL—9062)
WASTE WATER/RESOURCE POTENTIAL
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
WASTE WATER/USES
Municipal waste water as a source of cooling water for California electric power plants, 5:33588 (P—300-80-021)
WASTE WATER/WATER TREATMENT
Potential uses of spent shale in the treatment of oil shale retort waters, 5:33299 (LBL—11072)
WASTE-FUELED POWER PLANTS
See REFUSE-FUELED POWER PLANTS
WATER
See also GROUND WATER
HEAVY WATER
SURFACE WATERS
WATER/ENVIRONMENTAL TRANSPORT
In-situ tuff water migration/heater experiment: experimental plan, 5:33333 (SAND—79-1276)
WATER/FILM BOILING
Experimental study of falling liquid film breakdown on a horizontal cylinder during heat transfer, 5:34039
WATER/FILM FLOW
Experimental study of falling liquid film breakdown on a horizontal cylinder during heat transfer, 5:34039
WATER/RADIOCHEMICAL ANALYSIS
Radiological survey of the radioactive sands and residues at Lowman, Idaho, 5:34151 (ORNL—5465)
WATER CURRENT POWER GENERATORS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
WATER HEATERS
See also ANNUAL CYCLE ENERGY SYSTEM
WATER HEATERS/ECONOMIC ANALYSIS
User's Guide to Solar Finance 2 (SOLFIN2): a computer code for the economic evaluation of alternative end-use energy systems in buildings, 5:33386 (P—104-80-002)
WATER HYACINTHS/ANAEROBIC DIGESTION
Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
WATER HYACINTHS/CULTIVATION TECHNIQUES
Cultivation of macroscopic marine algae and freshwater aquatic needs. Progress report, May 1, 1979-December 15, 1979, 5:33421 (DOE/CH/00178—T5)
WATER HYACINTHS/GROWTH
Methane production by anaerobic digestion of water hyacinth (Eichhornia crassipes), 5:33418 (CONF-800814—7)
WATER RESOURCES/EVALUATION
Inputs for risk analysis in water systems, 5:34159
Reliability in water resources management, 5:34160
WATER RESOURCES/MEETINGS
Inputs for risk analysis in water systems, 5:34159
Reliability in water resources management, 5:34160
WATER SPRINGS/ISOTOPE RATIO
Light stable isotope study of the Roosevelt Hot Springs thermal area, Southwestern Utah, 5:33560 (DOE/ET/28392—46)
WATER TREATMENT/WASTE PRODUCT UTILIZATION
Potential uses of spent shale in the treatment of oil shale retort waters, 5:33299 (LBL—11072)
WATER VAPOR/CHEMICAL REACTIONS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
WATER VAPOR/METALLURGICAL EFFECTS
Fracture mechanics and surface-chemistry studies of steels for coal-gasification systems. Final technical report, 5:33188 (IFSM—80-104)
WATER WALLS/SPECTRALLY SELECTIVE SURFACES
Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)
WATER WALLS/THERMAL INSULATION
Performance of night insulation and selective absorber coatings in LASL test cells, 5:33479 (LA-UR—80-2268)
WATER WAVES/MAGNETIC FIELDS
Measurements of magnetic gradients from ocean waves, 5:33968
WATERFLOODING/DEMONSTRATION PROGRAMS
Enhanced oil recovery by improved waterflooding. Second annual report, 5:33245 (DOE/ET/12065—26)
WATERFLOODING/SURFACTANTS
Enhanced recovery of Pennsylvania grade crude oil with surfactant solutions. Annual report, October 1978-September 1979, 5:33244 (DOE/BC/20009—8)
WAVE ENERGY CONVERTERS/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)
WAVEGUIDES/MAXWELL EQUATIONS
Electromagnetic fields in an axial symmetric waveguide with variable cross section, 5:34390 (SLAC-PUB—2547)
WAVES (SHOCK)
See SHOCK WAVES
WAY OF LIFE
See LIFE STYLES
WAZ 16
See NICKEL BASE ALLOYS
WEAK INTERACTIONS
Critical review of a quantitative study of a specialty in high energy particle physics, 5:34392 (BNL—28145)
WEAK PARTICLE DECAY
See also RADIATIVE DECAY
WEAK PARTICLE DECAY/QUANTUM OPERATORS
Penguins and the $\Delta I = 1/2$ rule, 5:34290 (FERMILAB-CONF—80/66-THY)
WEIGHING
See BALANCES
WELDED JOINTS/MECHANICAL PROPERTIES
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
WELDED JOINTS/MICROSTRUCTURE
Ultrasonic inspectability improvements of austenitic stainless steel welds after thermal-mechanical processing, 5:33851 (CONF-801021—3)
WELDS
See WELDED JOINTS
WELL DRILLING/PERMIT APPLICATIONS
Procedures for permit to drill for oil and gas in the Commonwealth of Virginia, 5:33702
WELL LOGGING/COMPUTER CODES
Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1), 5:33563 (DOE/ID/12079—1)
WELL LOGGING/DATA ANALYSIS
Computer system for digitizing, analyzing and plotting well log data (a user's guide to WELLOG.Rev.1), 5:33563 (DOE/ID/12079—1)
WEST GERMANY
See FEDERAL REPUBLIC OF GERMANY
WEST VIRGINIA/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 6. Northeast region, 5:33374 (DOE/RA/11025—T1(Vol.6))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
WIND POWER/AVAILABILITY
Wind Energy Task Force. Final report, 5:33582
WIND POWER/BIBLIOGRAPHIES
Solar thermal power generation: a bibliography with abstracts. Quarterly update, October-December 1979, 5:33379 (TAC-STPG—79-004)
Solar thermal power generation: a bibliography with abstracts. Quarterly update, January-March 1980, 5:33380 (TAC-STPG—80-001)
WIND POWER/RESOURCE ASSESSMENT
Wind Energy Task Force. Final report, 5:33582
WIND POWER PLANTS/ECONOMICS
A feasibility study of windpower for the New England area. Final technical report, 4 June-31 October 1979, 5:33583 (AD-A—076614)
Wind Energy Task Force. Final report, 5:33582
WIND POWER PLANTS/FEASIBILITY STUDIES
Wind energy in the mountains of New Hampshire as a potential energy source for the Portsmouth Naval Shipyard. Final report, 5:33586 (AD-A—076975)
Wind Energy Task Force. Final report, 5:33582
WIND TURBINES/AERODYNAMICS
Turbulence spectrum observed by a fast-rotating wind-turbine blade, 5:33584 (PNL—3426)
WIND TURBINES/NATIONAL PROGRAM PLANS
Department of Energy solar energy objectives, calendar year 1980, 5:33376 (DOE/CS—0155)

WINDOWS/PERFORMANCE TESTING
Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
WINDOWS/U VALUES
Calibrated hotbox for testing window systems: construction, calibration, and measurements on prototype high-performance windows, 5:33765 (LBL—9803)
WINSTON COLLECTORS
See COMPOUND PARABOLIC CONCENTRATORS
WISCONSIN/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 4. Lake Central region, 5:33372 (DOE/RA/11025—T1(Vol.4))
Summary of the Midwest conference on small-scale hydropower in the Midwest: an old technology whose time has come, 5:33375 (DOE/RA/04934—05)
WOMEN
Affirmative Action Compliance Program for Fiscal Year 1980, 5:34440 (PUB—367)
WOOD/COMBUSTION
Environmental and health aspects of biomass energy systems, 5:34116 (CONF-800814—11)
WOOD/DECOMPOSITION
Controlling biological deterioration of wood with volatile chemicals. Final report, 5:33604 (EPRI-EL—1480)
WOOD/ENERGY SOURCE DEVELOPMENT
Energy from biological processes, 5:33429 (OTA-E—124)
WOOD/GASIFICATION
Production of methanol from wood, 5:33363 (CONF-790520—)
WOOD/MARKETING
Economies in fuel wood supply firms in New Hampshire, 5:33436
Marketing fuel wood in New Hampshire, 5:33439
WOOD/PRESERVATION
Controlling biological deterioration of wood with volatile chemicals. Final report, 5:33604 (EPRI-EL—1480)
WOOD/PRODUCTION
Economies in fuel wood supply firms in New Hampshire, 5:33436
WOOD BURNING APPLIANCES/ENVIRONMENTAL IMPACTS
Environmental and health aspects of biomass energy systems, 5:34116 (CONF-800814—11)
WOOD PRODUCTS INDUSTRY/ENERGY CONSERVATION
Reductions in energy usage at Manitoba Forestry Resources: energy conservation, fuel oil substitution and electrical cost control, 5:33793 (CONF-7905177—1)
WOOD PRODUCTS INDUSTRY/FUEL SUBSTITUTION
Reductions in energy usage at Manitoba Forestry Resources: energy conservation, fuel oil substitution and electrical cost control, 5:33793 (CONF-7905177—1)
WOOD WASTES/RESOURCE POTENTIAL
Wood waste for energy study: inventory assessment and economic analysis, 5:33366 (NP—25084)
Wood waste for energy study: executive summary, 5:33365 (NP—25083)
WORKERS
See PERSONNEL
WYOMING/HYDROELECTRIC POWER
National hydroelectric power resources study. Preliminary inventory of hydropower resources. Volume 3. Mid-Continent region, 5:33371 (DOE/RA/11025—T1(Vol.3))
WYOMING/MINERAL RESOURCES
Minerals in the economy of Wyoming, 5:33684

X

X RADIATION/GENETIC RADIATION EFFECTS
Expression of embryonic hemoglobin genes in α-thalassemic and in β-duplication mice, 5:34228 (CONF-7905172—1)
XENON/AUTOIONIZATION
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
XENON/ENERGY-LEVEL TRANSITIONS
Analysis of Beutler-Fano autoionizing resonances in the rare-gas atoms using the relativistic multichannel quantum-defect theory, 5:34243
XENON/PHOTOIONIZATION
Resonantly enhanced multiphoton ionization and third-harmonic generation in xenon gas, 5:33921
X-RAY EQUIPMENT/FILMS
Soft x-ray transmission gratings, 5:34097 (CONF-800719—11)
X-RAY RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY

Y

YANG-MILLS THEORY/FEYNMAN DIAGRAM
Operator ordering and Feynman rules in gauge theories, 5:34305
YANG-MILLS THEORY/HAMILTONIANS
Operator ordering and Feynman rules in gauge theories, 5:34305
YTTERBIUM/ACTIVATION ANALYSIS
Elko 1° x 2° NTMS area: Nevada and Utah. Data report, 5:33303 (GJBX—163(80))
YTTRIUM HYDRIDES/CRYSTAL STRUCTURE
Electronic structure of nonstoichiometric cubic hydrides, 5:34372 (SAND—79-1540C)
YTTRIUM HYDRIDES/OPTICAL PROPERTIES
Electronic band structure and optical properties of the cubic, Sc, Y and La hydride systems, 5:33866 (IS-T—899)
YTTRIUM OXIDES/PERMEABILITY
Tritium diffusion in nonmetallic solids of interest for fusion reactors. Final report, 5:34419 (DOE/ET/52022—5)

Z

ZEA MAYS
See MAIZE
ZEOLITES/CATALYTIC EFFECTS
Hydrocarbon cracking catalyst (Patent), 5:33255
Hydrocracking with catalyst modified by group IIA (Patent), 5:33251
Selective hydrocracking process for middle distillate (Patent), 5:33252
Synthesis gas conversion to gasoline range hydrocarbons over medium pore zeolite catalysts containing 3d-metals and bimetallics, 5:33191
ZEOLITES/ION EXCHANGE
Tabulation and evaluation of ion exchange data on smectites, certain zeolites and basalt, 5:33325 (LBL—10541)
ZINC/SPECTROPHOTOMETRY
Comparison of four digestion procedures not requiring perchloric acid for the trace-element analysis of plant material, 5:34146 (ANL/LRP-TM—18)
ZINC/TOXICITY
Possible adverse effects of trace materials, 5:34206 (BNL—51118)
ZINC ALLOYS/DEFORMATION
Relation between the strain rate sensitivity parameter and deformation mechanism in superplasticity, 5:33865
ZINC ALLOYS/DENSITY
Density measurements at high temperatures. Part XII. Specific volume and expansion of magnesium-zinc alloys in the solid and liquid states, 5:33883 (RFP-Trans—285)
ZINC ALLOYS/MUON REACTIONS
Negative muon capture ratios for alloys and alkali halide solid solutions, 5:34250 (LA—8407-PR)
ZINC CHLORIDES/CATALYTIC EFFECTS
Regeneration of spent $ZnCl_2$ product catalyst from hydrocracking subbituminous coal, 5:33209
ZINC-AIR BATTERIES/DESIGN
Air battery and electrochemical method (Patent), 5:33645
Electrochemical generators with auxiliary cathode (Patent), 5:33650
ZINC-CHLORINE BATTERIES/CATHODES
Halogen electrodes and storage batteries (Patent), 5:33662
ZINC-CHLORINE BATTERIES/ELECTROLYTES
Rechargeable zinc halogen battery (Patent), 5:33651
ZIRCONATES/DOMAIN STRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
ZIRCONATES/MICROSTRUCTURE
Microstructure and domain structure of PZT, 5:33914 (LBL—10651)
ZIRCONIUM 90 TARGET/ALPHA REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
ZIRCONIUM 90 TARGET/DEUTERON REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
ZIRCONIUM 90 TARGET/HELIUM 3 REACTIONS
Nucleus-nucleus total reaction cross sections, 5:34317
ZIRCONIUM BORIDES/ELECTRONIC STRUCTURE
Self-consistent electronic structure of the refractory metal ZrB_2, a pseudographite intercalation compound, 5:33907
ZIRCONIUM BORIDES/PHOTOEMISSION
Self-consistent electronic structure of the refractory metal ZrB_2, a pseudographite intercalation compound, 5:33907

CONTRACT NUMBER INDEX

Numbers assigned to DOE contracts under which reports announced in this publication were prepared are included in this index.

Contract No.	*Abstract No.*	*Report No.*
AA01-78ET12276	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	5:33241	DOE/ET/12276—T1
AB01-76CS31020	**Boeing Co., Seattle, WA (USA)**	
	5:33485	SOLAR/1001—80/50
	5:33486	SOLAR/1012—80/50
	5:33487	SOLAR/1024—80/50
	5:33488	SOLAR/1029—80/50
AB01-77CS34084	**Stephens Coll., Columbia, MO (USA). Building and Grounds Dept.**	
	5:33467	DOE/NASA/CR—161485
AB21-80MC14522	**TRW Energy Systems Planning Div., Morgantown, WV (USA)**	
	5:33184	DOE/METC/SP—80/8
AC01-77ET-13031	**Illinois Coal Gasification Group, Chicago (USA)**	
	5:33185	FE—2012-096(App.)
AC01-76ET12153	**Dow Chemical Co., Midland, MI (USA). Process Development Dept.**	
	5:33291	FE—2346-74
AC01-76PE03871	**Little (Arthur D.), Inc., Cambridge, MA (USA)**	
	5:33775	DOE/PE/03871—T1
AC01-77ET12065	**Energy Resources Co., Inc., Cambridge, MA (USA)**	
	5:33245	DOE/ET/12065—26
AC01-77ET13031	**Illinois Coal Gasification Group, Chicago (USA)**	
	5:33186	FE—2012-096(Sect.4)
	5:33189	FE—2012-096(Sect.1)(Exec.Summ.)
AC01-77ET26934	**Little (Arthur D.), Inc., Cambridge, MA (USA)**	
	5:33594	DOE/ET/26934—1
AC01-77RG08753	**Department of Energy, Washington, DC (USA). Economic Regulatory Administration**	
	5:33269	DOE/EA—0061
AC01-78CS24216	**Greenbrier Associates, Chesapeake, VA (USA)**	
	5:33800	DOE/CS/24216—1
AC01-78ET10254	**Bituminous Coal Research, Inc., Monroeville, PA (USA)**	
	5:33182	DOE/ET/10254—82
AC01-78ET10328	**Rockwell International Corp., Canoga Park, CA (USA). Environmental and Energy Systems Div.**	
	5:33187	FE—3125-21
AC01-78ET11328	**Pittsburg and Midway Coal Mining Co., Denver, CO (USA)**	
	5:33198	DOE/ET/11328—T1
AC01-78ET13513	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**	
	5:33859	DOE/ET/13513—T1
	5:33860	DOE/ET/13513—T2
AC01-79EI10553	**National Academy of Sciences - National Research Council, Washington, DC (USA)**	
	5:33672	DOE/EI/10553—T1
AC01-79ET10023	**Kaiser Engineers, Oakland, CA (USA)**	
	5:33231	DOE/ET/10023—T6
AC01-79ET10815	**Tennessee Univ., Tullahoma (USA). Space Inst.**	
	5:33745	DOE/ET/10815—T2
AC01-79ET14815	**Bituminous Coal Research, Inc., Monroeville, PA (USA)**	
	5:33183	DOE/ET/14815—12
AC01-79ET29372	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	5:33607	JPL-PUBL—80-48(Vol.2)
AC01-79PE70076	**Pace Co. Consultants and Engineers, Inc., Houston, TX (USA)**	
	5:33266	DOE/PE/70076—T1
AC01-79PE70078	**RAND Corp., Santa Monica, CA (USA)**	
	5:33708	RAND/N—1469-DOE
AC01-79RA33001	**Mittelhauser Corp., El Toro, CA (USA)**	
	5:33225	DOE/RA/33001—01(Vol.1)
	5:33274	DOE/RA/33001—01(Vol.2)
AC02-76CH00016	**Brookhaven National Lab., Upton, NY (USA)**	
	5:33210	BNL—51172
	5:33352	BNL—51226
	5:33368	BNL—51092
	5:33387	BNL—51118
	5:33414	BNL—50982
	5:33664	BNL—51126
	5:33665	BNL—51199
	5:33690	BNL—51046
	5:33773	BNL—51171
	5:33789	BNL—50904
	5:33908	BNL—51194
	5:34068	BNL—27971
	5:34069	BNL—27972
	5:34070	BNL—28033
	5:34071	BNL—28131
	5:34079	BNL—27767
	5:34080	BNL—28214
	5:34093	BNL—28132
	5:34110	BNL—51149
	5:34142	BNL—51161
	5:34156	BNL—28136
	5:34161	BNL—28123
	5:34162	BNL—28173
	5:34163	BNL—51211
	5:34167	BNL—28030
	5:34249	BNL—28196
	5:34270	BNL—28142
	5:34284	BNL—28057
	5:34367	BNL—28157
	5:34392	BNL—28145
AC02-76CH00178	**Solar Energy Research Inst., Golden, CO (USA)**	
	5:33390	SERI/RR—722-329R
	5:33392	SERI/TR—733-394
AC02-76CH03000	**Joint Inst. for Nuclear Research, Dubna (USSR)**	
	5:34273	FERMILAB-CONF—80/56-EXP
	5:34281	FERMILAB-CONF—80/57-EXP
	5:34289	FERMILAB-CONF—80/63-THY

Contract No.	Abstract No.	Report No.
	5:34290	FERMILAB-CONF—80/66-THY
	5:34301	FERMILAB-CONF—80/68-THY
	5:34302	FERMILAB-CONF—80/69
AC02-76CS40031	**McDonnell Aircraft Co., St. Louis, MO (USA)**	
	5:33794	DOE/CS/40031—T1
AC02-76CS52832	**Thermo Electron Corp., Waltham, MA (USA)**	
	5:33819	TE—4257-72-80
	5:33820	TE—4257-207-80
AC02-76ER01198	**Illinois Univ., Champaign (USA). Physics Research Lab.**	
	5:33902	DOE/ER/01198—134
	5:34263	DOE/ER/01198—T1
	5:34368	DOE/ER/01198—1311
AC02-76ER02232	**Rockefeller Univ., New York (USA)**	
	5:34272	DOE/ER/02232—88
AC02-76ER03071	**Pennsylvania Univ., Philadelphia (USA)**	
	5:34094	COO—3071-245
	5:34271	COO—3071-248
AC02-76ER03072	**Princeton Univ., NJ (USA). Joseph Henry Labs.**	
	5:34268	DOE/ER/03072—T2
AC02-76ER03077	**New York Univ., NY (USA). Courant Mathematics and Computing Lab.**	
	5:33942	COO—3077-162
	5:34172	COO—3077-163
	5:34400	COO—3077-164
AC02-76ET20279	**Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.**	
	5:33402	DOE/ET/20279—101
	5:33443	COO—4094-61
	5:33444	COO—4094-90
	5:33445	DOE/ET/20279—100
	5:33636	COO—4094-91
	5:33637	DOE/ET/20279—102
AC02-76ET34202	**General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.**	
	5:33857	COO—2975-43
AC02-76EV00069	**Franklin McLean Memorial Research Inst., Chicago, IL (USA)**	
	5:34174	FMI—45
AC02-76EV01340	**Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science**	
	5:34113	COO—1340-76
	5:34157	COO—1340-68(Draft)
AC02-76EV02814	**Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Biochemistry**	
	5:34169	DOE/EV/02814—1
AC02-76EV03221	**Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry**	
	5:33937	DOE/EV/03221—67
	5:34184	DOE/EV/03221—68
AC02-76EV03490	**Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics**	
	5:34183	UR—3490-1878
AC02-77CH00178	**Solar Energy Research Inst., Golden, CO (USA)**	
	5:33377	SERI/SP—763-717
	5:33391	SERI/SP—98156-1
	5:33406	SERI/PR—0-8274-3
	5:33407	SERI/PR—0-8276-3
	5:33408	SERI/PR—611-737
	5:33409	SERI/PR—8119-2-T1
	5:33410	SERI/PR—8119-2-T2
	5:33412	SERI/PR—9192-1-T1
	5:33421	DOE/CH/00178—T5
	5:33431	SERI/TR—8157-1-T1
	5:33446	SERI/TP—611-407
	5:33484	SERI/RR—431-328
	5:33504	SERI/RR—632-702
	5:33521	SERI/TR—334-601
	5:33546	SERI/RR—731-364
	5:33744	SERI/TP—744-661
AC02-77CS34412	**Fairbrother and Gunther, Inc., Grand Rapids, MI (USA)**	
	5:33464	DOE/CS/34412—16
AC02-77ET20174	**Research Triangle Inst., Research Triangle Park, NC (USA)**	
	5:33381	DOE/ET/20174—1
AC02-77ET34209	**Argonne National Lab., IL (USA)**	
	5:33611	DOE/ET/34209—T1
AC02-78CS54894	**ORI, Inc., Silver Spring, MD (USA)**	
	5:33849	CONF-800419—5
AC02-78ET20090	**Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)**	
	5:33384	DOE/ET/20090—4
AC02-78ET21002	**VSE Corp., Alexandria, VA (USA)**	
	5:33458	DOE/ET/21002—2
AC02-78ET28474	**Hudson Inst., Inc., Croton-on-Hudson, NY (USA)**	
	5:33286	COO—4955-1
AC02-79CS20258	**Illinois Univ., Urbana (USA). Office of Vice Chancellor for Research**	
	5:33694	DOE/CS/20258—2
	5:33710	DOE/CS/20258—3
AC02-79CS30108	**TPI, Inc., Beltsville, MD (USA)**	
	5:33462	DOE/CS/30108—T2
AC02-79ER10389	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering**	
	5:33858	DOE/ER/10389—1
AC02-80ET26225	**New Mexico State Univ., Las Cruces (USA)**	
	5:33354	GA-A—15935
AC0277CH00178	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
	5:33411	SERI/PR—8278-1-T3
AC03-76ET28434	**California State Univ., Chico (USA)**	
	5:33581	DOE/ET/28434—T1
AC03-76SF00012	**California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology**	
	5:34178	UCLA—12-1261
AC03-76SF00515	**Stanford Linear Accelerator Center, CA (USA)**	
	5:34059	SLAC-PUB—2480
	5:34075	SLAC-PUB—2548
	5:34085	SLAC-PUB—2526
	5:34276	SLAC-PUB—2519
	5:34279	SLAC-PUB—2517
	5:34280	SLAC-PUB—2532
	5:34288	SLAC-PUB—2503
	5:34291	SLAC-PUB—2510
	5:34294	SLAC-PUB—2505
	5:34390	SLAC-PUB—2547
	5:34450	SLAC-TN—80-2
AC03-77ET11320	**Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)**	
	5:33755	DOE/ET/11320—T1
AC03-78ET11276	**Institute of Gas Technology, Chicago, IL (USA)**	
	5:33754	SAN—11276-4
AC03-78ET11300	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**	
	5:33749	DOE/ET/11300—
	5:33750	DOE/ET/11300—1
	5:33751	DOE/ET/11300—T1
	5:33752	DOE/ET/11300—T2
	5:33753	DOE/ET/11300—T3
AC03-78ET12297	**Combustion Power Co., Inc., Menlo Park, CA (USA)**	
	5:33237	CONF-800428—7
AC03-78ET13101	**Wyoming Univ., Laramie (USA)**	
	5:33290	DOE/LETC—1761-2/1
AC03-78SF01424	**Conoco, Inc., Casper, WY (USA)**	
	5:33246	DOE/SF/01424—26
AC03-79SF10606	**Foster Wheeler Corp., Livingston, NJ (USA)**	
	5:33491	DOE/SF/10606—1/1
	5:33492	DOE/SF/10606—1/2
	5:33493	DOE/SF/10606—1(App.)
AC03-79SF10608	**McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)**	
	5:33494	DOE/SF/10608—1
AC03-79SF10608	**McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)**	
	5:33495	DOE/SF/10608—(Exect.Summ.)
AC03-79SF10736	**Northrup, Inc., Hutchins, TX (USA)**	
	5:33496	DOE/SF/10736—1/1
	5:33497	DOE/SF/10736—1/2
	5:33498	DOE/SF/10736—1/3
AC03-79SF10737	**Martin Marietta Corp., Denver, CO (USA)**	
	5:33499	DOE/SF/10737—1
	5:33500	DOE/SF/10737—1(Exect.Summ.)
AC03-79SF10742	**United States Gypsum Co., Sweetwater, TX (USA)**	
	5:33501	DOE/SF/10742—1(Exec.Summ.)
	5:33502	DOE/SF/10742—1(Vol.1)
	5:33503	DOE/SF/10742—1(Vol.2)
AC03-80CS30218	**Middlebury Coll., VT (USA)**	
	5:33518	DOE/CS/30218—1

Contract No.	Abstract No.	Report No.
AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
	5:33289	MLM-MU—80-68-0002
	5:34102	MLM—2762(OP)
	5:34139	MLM—2758
AC04-76DP00613	**Bendix Corp., Kansas City, MO (USA)**	
	5:33850	BDX—613-2397
	5:33884	BDX—613-2396
	5:33901	BDX—613-2398
	5:33944	BDX—613-2300
	5:33945	BDX—613-2373
	5:33946	BDX—613-2401
	5:33947	BDX—613-2421
	5:34050	BDX—613-2392
	5:34051	BDX—613-2458
	5:34052	BDX—613-2466
	5:34053	BDX—613-2478
AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (USA)**	
	5:33248	SAND—80-1019
	5:33249	SAND—80-1292
	5:33292	SAND—80-0777
	5:33293	SAND—80-1873C
	5:33330	SAND—79-0284
	5:33331	SAND—79-0377
	5:33332	SAND—79-1110
	5:33333	SAND—79-1276
	5:33334	SAND—80-0312C
	5:33335	SAND—80-1533C
	5:33336	SAND—80-1606C
	5:33339	SAND—80-7107
	5:33348	SAND—80-7097
	5:33565	SAND—80-0444C
	5:33571	SAND—80-1585
	5:33572	SAND—80-7101
	5:33573	SAND—80-7102
	5:33585	SAND—80-0085
	5:33612	SAND—80-1428C
	5:33638	SAND—80-7019
	5:33675	SAND—80-1871C
	5:33870	SAND—80-1038C
	5:33915	SAND—80-1838C
	5:33931	SAND—80-1642
	5:33949	SAND—80-0481
	5:33950	SAND—80-0697
	5:33951	SAND—80-1315C
	5:33952	SAND—80-1380C
	5:33953	SAND—80-1482
	5:33954	SAND—80-1534
	5:33955	SAND—80-1877C
	5:34032	SAND—80-0261
	5:34048	SAND—80-8733
	5:34055	SAND—78-1065
	5:34056	SAND—79-0688
	5:34057	SAND—79-1490
	5:34058	SAND—80-0420C
	5:34084	SAND—80-1388C
	5:34100	SAND—80-8222
	5:34103	SAND—80-1157
	5:34104	SAND—80-8216
	5:34372	SAND—79-1540C
	5:34373	SAND—80-1697C
	5:34426	SAND—80-1546
	5:34448	SAND—80-1124
	5:34449	SAND—80-1146
	5:34460	SAND—80-1252C
AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
	5:33320	RFP—2945
	5:33328	RFP—3110
AC04-76EV01013	**Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA)**	
	5:34198	LMF—75
AC04-77DP00053	**Mound Facility, Miamisburg, OH (USA)**	
	5:33939	MLM—2727
AC04-78CS34298	**Florida Univ., Gainesville (USA). Solar Energy Lab.**	
	5:33459	ALO—4298-2
AC04-78CS35363	**Versar, Inc., Springfield, VA (USA)**	
	5:33465	DOE/CS/35363—T1
AC04-79AL12032	**Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.**	
	5:33513	ALO—2032-2
AC04-79CS10510	**Battelle Columbus Labs., OH (USA)**	
	5:33514	DOE/CS/10510—T9
	5:33515	DOE/CS/10510—T10
	5:33516	DOE/CS/10510—T11
	5:33517	DOE/CS/10510—T12
AC05-76ET15343	**Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA). Government Products Div.**	
	5:33795	DOE/OR/05035—T1
AC05-76ET53036	**Texas Univ., Austin (USA). Fusion Research Center**	
	5:34401	DOE/ET/53036—17
AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Tranining Div.**	
	5:33232	ORAU—168
	5:33817	ORAU—170
AC05-76OR05035	**Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA). Government Products Div.**	
	5:33795	DOE/OR/05035—T1
AC05-77CS55438	**Exxon Research and Engineering Co., Linden, NJ (USA)**	
	5:33787	DOE/CS/05438—T1(Vol.1)
	5:33788	DOE/CS/05438—T1(Vol.2)
AC05-78EV06020	**Applied Technology Corp., Norman, OK (USA)**	
	5:33270	DOE/EV/06020—T3
AC05-79ET27228	**Burns and Roe Industrial Services Corp., Paramus, NJ (USA)**	
	5:33578	DOE/ET/27228—T1
AC06-76RL01830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
	5:33233	PNL—3468
	5:33317	PNL—3290
	5:33318	PNL-SA—8014
	5:33319	PNL-SA—8414
	5:33405	PNL-SA—7778
	5:33564	PNL—3377
	5:33584	PNL—3426
	5:33589	PNL-SA—7422
	5:33592	PNL—3458
	5:33627	PNL-SA—8017
	5:33635	PNL—3399
	5:33863	PNL-SA—8295
	5:33930	PNL—2579
	5:34121	EPRI-EA—1498(Vol.1)
	5:34129	PNL-SA—7658
	5:34130	PNL-SA—8170
	5:34131	PNL-SA—8431
	5:34187	PNL-SA—8106
	5:34188	PNL-SA—8110
	5:34192	PNL-SA—8291
	5:34218	PNL-SA—8202
	5:34223	PNL—2882
	5:34226	ONWI—95
	5:34227	ONWI—99
	5:34257	PNL-SA—7417
AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
	5:33321	RHO-SA—174
	5:33329	RHO-BWI-CD—35
AC07-76ID01570	**Idaho National Engineering Lab., Idaho Falls (USA)**	
	5:33570	EGG-FM—5170
	5:33577	CONF-801014—1
	5:33610	CONF-800747—5
	5:33629	CONF-801107—6
	5:33632	CONF-800747—4
	5:33851	CONF-801021—3
	5:34087	CONF-800747—3
	5:34418	CONF-801011—1
	5:34420	EGG—2018
AC07-78ET28392	**Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics**	
	5:33551	DOE/ET/28392—41
	5:33552	DOE/ET/28392—44
	5:33555	DOE/ET/28392—42
	5:33559	DOE/ET/28392—43
	5:33560	DOE/ET/28392—46
AC07-79ID01675	**Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)**	
	5:33617	ENICO—1046

Contract No.	Abstract No.	Report No.
AC07-79ID12079	**Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics**	
	5:33553	DOE/ID/12079—4
	5:33561	DOE/ID/12079—3
	5:33562	DOE/ID/12079—6
	5:33563	DOE/ID/12079—1
AC08-76NV01183	**EG and G, Inc., Goleta, CA (USA)**	
	5:34098	EGG—1183-2369
AC08-79BC10003	**CER Corp., Las Vegas, NV (USA)**	
	5:33285	DOE/BC/10003—10
AC08-80NV10061	**Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.**	
	5:33309	DOE/NV/10061—3
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	5:33312	DP—79-125-3
	5:33313	DP-MS—80-73
	5:33316	DOE/TIC—11219
	5:33323	DP-MS—80-47
	5:33340	DPSP U—79-30-19
	5:33861	DP-MS—79-73
	5:33925	DP-MS—80-17
	5:34154	DP—1525
	5:34194	DP-MS—80-37
AC09-78ET35900	**Allied-General Nuclear Services, Barnwell, SC (USA)**	
	5:33306	AGNS—35900-CONF-71
	5:33341	AGNS—35900-Conf-85
AC13-76GJ01664	**Bendix Field Engineering Corp., Grand Junction, CO (USA)**	
	5:33301	GJBX—124(80)
	5:33302	GJBX—160(80)
AC13—76GJ01664	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	5:33303	GJBX—163(80)
AC13-76GJ01664	**Oak Ridge National Lab., TN (USA)**	
	5:33304	GJBX—164(80)
	5:34108	USGS-OFR—80-817
	5:34165	GJBX—161(80)
AC14-76FF02170	**Westinghouse Hanford Co., Richland, WA (USA)**	
	5:33310	HEDL-SA—2138
	5:33619	HEDL-SA—2112-FD
	5:33620	HEDL-TME—79-78
	5:33852	HEDL-SA—2189
	5:34082	HEDL-SA—2123-FP
	5:34088	HEDL-SA—2041
	5:34436	HEDL-SA—2019-FP
AC19-79BC20001	**Texas Univ., Austin (USA)**	
	5:33243	DOE/BC/20001—6
AC22-79ET14858	**Chem Systems, Inc., Fairfield, NJ (USA)**	
	5:33361	DOE/ET/14858—2
AC32-79AL10563	**Republic Geothermal, Inc., Santa Fe Springs, CA (USA)**	
	5:33550	DOE/AL/10563—T5
	5:33576	DOE/AL/10563—T4
AI01-76CS31024	**Stephens Coll., Columbia, MO (USA). Building and Grounds Dept.**	
	5:33467	DOE/NASA/CR—161485
AI01-76CS31037	**IBM Federal Systems Div., Huntsville, AL (USA)**	
	5:33468	DOE/NASA/CR—161491
	5:33469	DOE/NASA/CR—161507
	5:33470	DOE/NASA/CR—161509
	5:33471	DOE/NASA/CR—161520
	5:33509	DOE/NASA/CR—161512
AI01-76ET28390	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
	5:33776	JHU/APL-GEM—007
AI01-77CS51040	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	5:33822	DOE/NASA/1040—17
	5:33839	DOE/NASA/1040—16
AI01-77CS51041	**Ford Motor Co., Dearborn, MI (USA). Research Staff**	
	5:33821	DOE/NASA/0008—80/11
AI01-77DP40042	**Naval Research Lab., Washington, DC (USA)**	
	5:34424	NRL-MR—4180
AI01-77ET13711	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	5:33747	DOE/NASA/1062—6
AI01-77RA11025	**Institute for Water Resources (Army), Fort Belvoir, VA (USA)**	
	5:33369	DOE/RA/11025—T1(Vol.1)
	5:33370	DOE/RA/11025—T1(Vol.2)
	5:33371	DOE/RA/11025—T1(Vol.3)
	5:33372	DOE/RA/11025—T1(Vol.4)
	5:33373	DOE/RA/11025—T1(Vol.5)
	5:33374	DOE/RA/11025—T1(Vol.6)
AI01-79ET20307	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	5:33452	DOE/JPL—1060-31(Vol.2)
	5:33453	DOE/JPL—1060-38(Rev.1)
AI01-79ET27025	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
	5:33776	JHU/APL-GEM—007
AI03-79ET11272	**Eco-Control, Inc., Cambridge, MA (USA)**	
	5:33756	DOE/NASA/0150—80/4
AI08-76DP00474	**Geological Survey, Washington, DC (USA)**	
	5:34224	USGS-OFR—80-611
AI21-79MC10866	**Geological Survey, Reston, VA (USA)**	
	5:33288	DOE/METC/10866—18
AM02-76CH03073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
	5:34236	PPPL—1683
	5:34395	PPPL—1692
	5:34398	PPPL—1688
AM03-76SF00012	**California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology**	
	5:34175	UCLA—12-1257
	5:34176	UCLA—12-1258
AS01-76ET10647	**Lehigh Univ., Bethlehem, PA (USA)**	
	5:33188	IFSM—80-104
AS01-77ET10533	**West Virginia Univ., Morgantown (USA). Coal Research Bureau**	
	5:33219	DOE/ET/10533—9
AS01-78ET13381	**Pennsylvania State Univ., University Park (USA)**	
	5:33199	DOE/ET/13381—T1
	5:33200	DOE/ET/13381—T2
AS02-76DP40050	**Rochester Univ., NY (USA). Inst. of Optics**	
	5:33912	DOE/DP/40050—9
AS02-76ER01569	**Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy**	
	5:34375	DOE/ER/01569—149
	5:34377	DOE/ER/01569—146
	5:34378	DOE/ER/01569—147
AS02-76ER02718	**Missouri Univ., St. Louis (USA)**	
	5:34256	COO—2718-8
AS02-76ER02978	**Cincinnati Univ., OH (USA)**	
	5:34299	COO—2978-4
AS02-76ET28320	**Southeastern Massachusetts Univ., North Dartmouth (USA)**	
	5:33568	DOE/RA/28320—1
AS02-76ET37240	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering**	
	5:33616	DOE/ET/37240—72
AS02-76ET53004	**Rensselaer Polytechnic Inst., Troy, NY (USA)**	
	5:34397	DOE/ET/53004—1
AS02-76ET53051	**Wisconsin Univ., Madison (USA)**	
	5:34408	COO—2387-118
	5:34433	COO—2387-117
	5:34434	DOE/ET/53051—5
	5:34435	DOE/ET/53051—6
AS02-76EV01300	**Wisconsin Univ., Madison (USA)**	
	5:34170	COO—1300-45
AS02-76EV01340	**Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science**	
	5:34112	COO—1340-75
AS02-76EV03083	**Pennsylvania Univ., Philadelphia (USA). Dept. of Biology**	
	5:34168	DOE/EV/03083—T1
AS02-77DP04515	**Pennsylvania State Univ., University Park (USA)**	
	5:34150	DOE/DP/04515—1
AS02-77ET29102	**Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering**	
	5:33701	PCTR—92-80
AS02-77ET53053	**Department of Energy, Washington, DC (USA). Office of Fusion Energy**	
	5:34394	DOE/ER—0070
AS02-77EV04580	**New England Aquarium Corp., Boston, MA (USA)**	
	5:34204	DOE/EV/04580—T1
AS02-78ER05023	**Northern Illinois Univ., DeKalb (USA)**	
	5:34081	DOE/ER/05023—1
AS02-78ET29185	**Wisconsin Univ., Madison (USA)**	
	5:33608	DOE/ET/29185—17

Contract No.	Abstract No.	Report No.
AS02-78RA04934	Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center	
	5:33375	DOE/RA/04934—05
	5:33598	DOE/RA/23220—01
AS05-76ER03992	Texas Univ., Austin (USA). Center for Particle Theory	
	5:34300	DOE/ER/03992—392
AS05-76ER05246	Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station	
	5:33885	DOE/ER/05246—4
AS05-76ET52022	North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering	
	5:34419	DOE/ET/52022—5
AS05-76EV04700	Arkansas Univ., Fayetteville (USA). Dept. of Agronomy	
	5:34152	DOE/EV/04700—T1
AS05-78CS35760	Delaware Univ., Newark (USA). Dept. of Mechanical and Aerospace Engineering	
	5:33641	DOE/CS/35760—T1
AS05-78EV06047	Florida Univ., Gainesville (USA). Center for Wetlands	
	5:34148	CONF-800350—
AS05-80EV10343	Vanderbilt Univ., Nashville, TN (USA). Medical Center	
	5:34173	DOE/EV/10343—4
	5:34191	DOE/EV/10303—5
	5:34193	DOE/EV/10343—6
AS07-78ID01756	New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.	
	5:33547	NMEI—50
AS09-76EV00637	Georgia Univ., Athens (USA). Research Foundation	
	5:34181	DOE/EV/00637—9
AS09-76EV00641	Georgia Univ., Athens (USA). Inst. of Ecology	
	5:34117	DOE/EV/00641—42
	5:34144	DOE/EV/00641—34
	5:34149	DOE/EV/00641—37
	5:34171	DOE/EV/00641—38
	5:34182	DOE/EV/00641—41
AS19-78BC20009	Pennsylvania State Univ., University Park (USA)	
	5:33244	DOE/BC/20009—8
AS22-78ET00222	Cincinnati Univ., OH (USA). Dept. of Environmental Health	
	5:34201	DOE/ET/00222—4
AT01-77CS26010	National Engineering Lab. (NBS), Washington, DC (USA)	
	5:33768	NBS-BSS—114
	5:33785	NBS-BSS—113
AT01-77CS36010	National Bureau of Standards, Washington, DC (USA). Center for Building Technology	
	5:33520	NBS-BSS—117
AT03-76ET35300	General Atomic Co., San Diego, CA (USA)	
	5:33613	GA-A—15942
	5:33886	GA-A—15825
AT03-76ET51011	General Atomic Co., San Diego, CA (USA)	
	5:34399	GA-A—15963
AT03-76SF70030	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
	5:33862	GEFR-SP—205
AT03-76SF71023	General Atomic Co., San Diego, CA (USA)	
	5:33618	GA-A—15932
AT21-80MC14085	TRW Energy Systems Planning Div., Morgantown, WV (USA)	
	5:33184	DOE/METC/SP—80/8
ET-78-C-01-3122	Public Service Electric and Gas Co., Newark, NJ (USA)	
	5:33602	CONS—3122-T2
ET-78-I-01-3112	Escher Technology Associates, St. Johns, MI (USA)	
	5:33350	DOE/JPL—955492(Vol.2)(Pt.1)
	5:33351	DOE/JPL—955492(Vol.2)(Pt.2)
	5:33353	DOE/JPL—955492(Vol.1)
EX-76-A-29-1020	Jet Propulsion Lab., Pasadena, CA (USA)	
	5:33540	DOE/JPL—1060-12(Vol.2)
EX-76-A-29-1020-4001	American Planning Association, Chicago, IL	
	5:33472	HUD-PDR—481
EX-76-A-29-1060	Jet Propulsion Lab., Pasadena, CA (USA)	
	5:33539	DOE/JPL—1060-12(Vol.1)
EX-76-C-01-2270	Catalytic, Inc., Wilsonville, AL (USA)	
	5:33201	FE—2270-48
EX-76-C-01-2471	Exxon Research and Engineering Co., Florham Park, NJ (USA). Engineering Technology Dept.	
	5:34065	FE—2471-45
EX-76-S-01-2496	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering	
	5:33220	FE—2496-42
EY-76-C-02-0016	Brookhaven National Lab., Upton, NY (USA)	
	5:34438	BNL—50973
FC02-80CS30377	National Homes Corp., Lafayette, IN (USA)	
	5:33463	DOE/CS/30377—1
FC07-79ID12018	Colorado Geological Survey, Denver (USA)	
	5:33566	DOE/ID/12018—2
FG01-78ET20023	California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences	
	5:33420	CONF-8006100—1
	5:34143	CONF-8006101—1
	5:34180	CONF-8004108—1
FG01-78ET20049	Kansas State Univ., Manhattan (USA). Dept. of Forestry	
	5:33422	DOE/ET/20049—T1
FG01-78ET20593	Seattle City Light, WA (USA). Dept. of Lighting Conservation	
	5:33423	DOE/ET/20593—T1
FG02-77CS34135	Ueland and Junker, Architects and Planners, Philadelphia, PA (USA)	
	5:33466	DOE/EG/34135—10
FG03-78RA23220	Washington Univ., Seattle (USA). Social Management of Technology Program	
	5:33598	DOE/RA/23220—01
FG03-79CS50015	Department of Energy, Washington, DC (USA). Office of Transportation Programs	
	5:33415	CONF-790520—
NAS-7-100-954873	Westinghouse Research and Development Center, Pittsburgh, PA (USA)	
	5:33403	DOE/JPL/954873—8
NAS-7-100-955267	Jet Propulsion Lab., Pasadena, CA (USA)	
	5:33606	JPL PUBL—80-48(Vol.1)
	5:33740	JPL PUB—80-48(Vol.2)
NAS-7-100-955283	Budd Co., Fort Washington, PA (USA). Technical Center	
	5:33835	DOE/JPL/955283—1
W-31-109-ENG-38	Argonne National Lab., IL (USA)	
	5:33173	ANL—80-46
	5:33177	ANL/CEN/FE—80-4
	5:33224	ANL/EMR—2(Vol.2B)
	5:33235	ANL/CEN/FE—80-5
	5:33236	ANL/CEN/FE—80-6
	5:33457	ANL/OTEC-PS—6
	5:33593	ANL—80-20
	5:33595	ANL/EES-TM—97
	5:33709	ANL/EES-TM—92
	5:33748	ANL—80-33
	5:33759	CONF-800210—4
	5:33801	ANL/CNSV-TM—36
	5:33802	ANL/CNSV-TM—40
	5:33926	ANL—80-71
	5:34109	ANL/EES-TM—93
	5:34146	ANL/LRP-TM—18
	5:34393	ANL/FPP/TM—135
W-7405-ENG-26	Oak Ridge National Lab., TN (USA)	
	5:33214	CONF-800814—9
	5:33226	ORNL/TM—7249
	5:33239	ORNL/TM—7377
	5:33240	CONF-800814—13
	5:33307	CONF-800802—12
	5:33314	ORO—778
	5:33315	CONF-800814—12
	5:33326	ORNL/Sub—79/13617/2
	5:33327	ORNL/TM—7201
	5:33347	K/OA—4748
	5:33596	EPRI-EA—1438
	5:33628	ORNL/TM—7305
	5:33633	DOE/TIC—11235
	5:33639	Y/DX—135
	5:33667	CONF-800212—
	5:33679	ORNL/TM—7186
	5:33769	ORNL/Sub—7470/1-V3
	5:33774	CONF-800835—2
	5:33803	CONF-790401—
	5:33813	

Contract No.	Abstract No.	Report No.
		ORNL/HUD/MIUS—53
	5:33929	CONF-800808—6
	5:34097	CONF-800719—11
	5:34116	CONF-800814—11
	5:34126	NLM/TIRC—80/2
	5:34128	ORNL/TM—7417
	5:34135	CONF-8004111—1
	5:34145	DOE/TIC—11249
	5:34151	ORNL—5465
	5:34158	ORNL/TM—7127
	5:34166	CONF-800819—2
	5:34185	CONF-791103—81
	5:34190	ORNL/CSD/TM—68
	5:34199	ORNL/EIS—130
	5:34200	CONF-800485—1
	5:34228	CONF-7905172—1
	5:34238	ORNL/TM—7405
	5:34306	CONF-800829—4
	5:34307	CONF-800829—5
	5:34308	CONF-800829—7
	5:34311	CONF-800829—6
	5:34388	ORNL/CSD—62
	5:34403	ORNL/TM—7407
	5:34413	ORNL/TM—7049
	5:34417	ORNL/TM—7422
	5:34442	CONF-800820—6
	5:34457	CONF-800820—5
W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	5:33267	LA—8497-MS
	5:33280	LA—8368-MS
	5:33300	LA—8440-MS
	5:33324	LA—8297-PR
	5:33342	LA—8313-M
	5:33349	LA—8454-PR
	5:33355	LA-UR—80-2400
	5:33461	DOE/CS—0127/1
	5:33475	LA-UR—80-1669
	5:33476	LA-UR—80-2231
	5:33477	LA-UR—80-2236
	5:33478	LA-UR—80-2266
	5:33479	LA-UR—80-2268
	5:33480	LA-UR—80-2328
	5:33481	LA-UR—80-2330
	5:33519	LA-UR—80-2329
	5:33545	LA-UR—80-2429
	5:33736	LA-UR—80-2354
	5:33762	LA—7689-M(Ver.2.1)
	5:33763	LBL—8678(Rev.1)
	5:33764	LBL—8688(Rev.1)
	5:33928	LA-UR—80-2414
	5:34021	LA-UR—80-1617
	5:34046	LA-UR—80-2039
	5:34047	LA-UR—80-2040
	5:34066	LA—8257-PR
	5:34067	LA—8444-MS
	5:34072	LA—8405-MS
	5:34073	LA—8442-MS
	5:34074	LA-UR—80-1855
	5:34076	LA-UR—80-1905
	5:34078	LA-UR—80-1945
	5:34083	LA-UR—80-1856
	5:34086	LA-UR—80-1946
	5:34095	LA-UR—80-1943
	5:34141	LA-UR—80-1753
	5:34225	LA-UR—79-3016
	5:34229	LA—8473-MS
	5:34233	LA-UR—80-2197
	5:34251	LA-UR—80-2373
	5:34252	LA-UR—80-2374
	5:34253	LA-UR—80-2375
	5:34254	LA-UR—80-2376
	5:34255	LA-UR—80-2377
	5:34274	LA-UR—80-1976
	5:34275	LA-UR—80-2371
	5:34293	LA-UR—80-2235
	5:34312	LA-UR—80-1919
	5:34313	LA—8179-MS
	5:34319	LA-UR—80-2427
	5:34325	LA-UR—80-1925
	5:34328	LA-UR—80-1977
	5:34346	LA—8394-MS
	5:34354	

Contract No.	Abstract No.	Report No.
		LA-UR—80-2496
	5:34366	LA-UR—80-1933
	5:34370	LA-UR—80-2182
	5:34371	LA-UR—80-2372
	5:34379	LA—8446-PR
	5:34402	LA-UR—80-2043
	5:34414	LA-UR—80-2406
	5:34415	LA-UR—80-2500
	5:34421	LA—8458-MS
	5:34422	LA—8469-MS
	5:34423	LA-UR—80-2499
	5:34443	LA—8095
	5:34444	LA-UR—80-1185
	5:34445	LA-UR—80-2342
	5:34446	LA-UR—80-2343
W-7405-ENG-48	**California Univ., Berkeley (USA). Lawrence Berkeley Lab.**	
	5:33247	LBL—11086
	5:33296	LBL—9062
	5:33299	LBL—11072
	5:33325	LBL—10541
	5:33337	UCRL—52749
	5:33338	UCRL—84613
	5:33343	UCRL—83398
	5:33344	UCRL—83399
	5:33432	UCRL—84136
	5:33522	UCID—18764
	5:33554	LBL—10540
	5:33569	LBL—11107
	5:33575	UCRL—84489
	5:33626	UCID—18672
	5:33634	UCRL—81944
	5:33666	LBL—11183
	5:33673	LBL—11349
	5:33674	LBL—11350
	5:33680	UCB/ERG—80-1
	5:33681	UCRL—84839
	5:33762	LA—7689-M(Ver.2.1)
	5:33763	LBL—8678(Rev.1)
	5:33764	LBL—8688(Rev.1)
	5:33765	LBL—9803
	5:33766	LBL—9821
	5:33767	LBL—10789
	5:33778	LBL—8894(Rev.)
	5:33779	LBL—9270
	5:33780	LBL—10705
	5:33853	LBL—9941
	5:33854	LBL—10994
	5:33868	LBL—10952
	5:33869	LBL—10995
	5:33871	UCRL—84440
	5:33888	LBL—11202
	5:33909	UCRL—83875
	5:33911	UCRL—83783
	5:33914	LBL—10651
	5:33923	UCID—18766
	5:33957	UCRL—83559
	5:34022	UCRL—15137
	5:34023	UCRL—84318
	5:34034	UCRL—84655
	5:34049	UCRL—52975
	5:34099	LBL—11017
	5:34105	UCRL—52921
	5:34106	UCRL—84587
	5:34125	LBL—11237
	5:34132	UCID—18771
	5:34133	UCRL—84339
	5:34134	UCRL—84677
	5:34137	LBL—11097
	5:34138	LBL—11192
	5:34153	UCRL—52966
	5:34177	LBL—9892
	5:34220	LBL—11178
	5:34221	UCRL—52956
	5:34222	UCRL—52969
	5:34309	UCID—18577
	5:34355	LBL—8957
	5:34360	LBL—11123
	5:34365	UCRL—84259(Rev.1)
	5:34380	LBL—10761
	5:34381	LBL—11055
	5:34394	

Contract No.	Abstract No.	Report No.
		DOE/ER—0070
	5:34416	LBL—11141
	5:34427	UCRL—52868
	5:34437	UCRL—84456
	5:34440	PUB—367
	5:34447	LBL—10189/1
	5:34451	UCRL—15258
	5:34452	UCRL—84446
	5:34458	LBL—10437
	5:34459	LBL—10648
W-7405-ENG-82	**Ames Lab., IA (USA)**	
	5:33215	IS-T—923
	5:33221	IS—4744
	5:33222	IS-M—289
	5:33223	IS-T—924
	5:33404	IS—4723
	5:33473	IS-M—286
	5:33474	IS-M—290
	5:33866	IS-T—899
	5:33867	IS-T—925
	5:33887	IS—4747
	5:33927	IS-T—910
	5:33934	IS-T—909
	5:33948	IS-T—928
	5:34045	IS-T—900
	5:34123	IS—4709
	5:34124	IS-M—285
	5:34369	IS—4737
W-7405-ENG-92-102	**Battelle Columbus Labs., OH (USA)**	
	5:33424	DOE/TIC—11247

REPORT NUMBER INDEX

The numbers assigned to all reports cited in the publication appear in the first column of the index. The citation numbers are included in the second column. Cross reference information and/or availability are included as appropriate. Abbreviations used in the availability column are elaborated at the end of the index.

Report No.	*Abstract No.*	*Availability*
AD-A-		
076414	5:33640	NTIS, PC A04/MF A01
076489	5:34107	NTIS, PC A02/MF A01
076492	5:34027	NTIS, PC A04/MF A01
076507	5:34028	NTIS, PC A02/MF A01
076514	5:33940	NTIS, PC A07/MF A01
076534	5:34231	NTIS, PC A10/MF A01
076578	5:34114	NTIS, PC A05/MF A01
076614	5:33583	NTIS, PC A11/MF A01
076768	5:34189	NTIS, PC A02/MF A01
076836	5:33512	Availability: Microfiche copies only
076907	5:33305	NTIS, PC A07/MF A01
076949	5:33278	NTIS, PC A03/MF A01
076958	5:33941	NTIS, PC A03/MF A01
076964	5:33924	NTIS, PC A04/MF A01
076975	5:33586	NTIS, PC A09/MF A01
077040	5:34029	NTIS, PC A02/MF A01
077103	5:34441	NTIS, PC A02/MF A01
077110	5:33935	NTIS, PC A03/MF A01
077112	5:33441	NTIS, PC A08/MF A01
077153	5:34030	NTIS, PC A02/MF A01
AES-		
1/80	5:33772	Griffith Univ., Brisbane, Australia
AGNS-		
35900-CONF-71	5:33306	NTIS, PC A02/MF A01
35900-Conf-85	5:33341	NTIS, PC A02/MF A01
ALO-		
2032-2	5:33513	NTIS, PC A05/MF A01
4298-2	5:33459	NTIS, PC A10/MF A01
ANL-		
80-20	5:33593	NTIS, PC A05/MF A01
80-33	5:33748	NTIS, PC A03/MF A01
80-46	5:33173	NTIS, PC A04/MF A01
80-71	5:33926	NTIS, PC A02/MF A01
ANL/CEN/FE-		
80-4	5:33177	NTIS, PC A02/MF A01
80-5	5:33235	NTIS, PC A02/MF A01
80-6	5:33236	NTIS, PC A02/MF A01
ANL/CNSV-TM-		
36	5:33801	NTIS, PC A06/MF A01
40	5:33802	NTIS, PC A02/MF A01
ANL/EES-TM-		
92	5:33709	NTIS, PC A04/MF A01
93	5:34109	NTIS, PC A03/MF A01
97	5:33595	NTIS, PC A06/MF A01
ANL/EMR-		
2(Vol.2B)	5:33224	NTIS, PC A06/MF A01
ANL/FPP/TM-		
135	5:34393	NTIS, PC A03/MF A01
ANL/LRP-TM-		
18	5:34146	NTIS, PC A03/MF A01
ANL/OTEC-PS-		
6	5:33457	NTIS, PC A08/MF A01
ANL/PHY-		
79-4	5:34330	NTIS, PC A99/MF A01
BCR-L-		
1115	5:33182	*See* DOE/ET/10254-82
BDX-		
613-2300	5:33944	NTIS, PC A03/MF A01
613-2373	5:33945	NTIS, PC A04/MF A01
613-2392	5:34050	NTIS, PC A02/MF A01
613-2396	5:33884	NTIS, PC A03/MF A01
613-2397	5:33850	NTIS, PC A03/MF A01
613-2398	5:33901	NTIS, PC A02/MF A01
613-2401	5:33946	NTIS, PC A05/MF A01
613-2421	5:33947	NTIS, PC A04/MF A01
613-2458	5:34051	NITS, PC A02/MF A01
613-2466	5:34052	NTIS, PC A02/MF A01
613-2478	5:34053	NTIS, PC A02/MF A01
BM-IC-		
8827	5:34147	Bureau of Mines, Pittsburgh, PA
BMFT-FB-T-		
80-033	5:33197	NTIS (US Sales Only), PC A07/MF A01
BNL-		
27767	5:34079	NTIS, PC A02/MF A01
27971	5:34068	NTIS, PC A02/MF A01
27972	5:34069	NTIS, PC A02/MF A01
28030	5:34167	NTIS, PC A02/MF A01
28033	5:34070	NTIS, PC A02/MF A01
28057	5:34284	NTIS, PC A02/MF A01
28123	5:34161	NTIS, PC A02/MF A01
28131	5:34071	NTIS, PC A02/MF A01
28132	5:34093	NTIS, PC A02/MF A01
28136	5:34156	NTIS, PC A02/MF A01
28142	5:34270	NTIS, PC A02/MF A01
28145	5:34392	NTIS, PC A03/MF A01
28157	5:34367	NTIS, PC A02/MF A01
28173	5:34162	NTIS, PC A02/MF A01
28196	5:34249	NTIS, PC A02/MF A01
28214	5:34080	NTIS, PC A02/MF A01
50904	5:33789	NTIS, PC A04/MF A01
50973	5:33574	NTIS, PC A06/MF A01
50973	5:33922	NTIS, PC A06/MF A01
50973	5:34376	NTIS, PC A06/MF A01
50973	5:34438	NTIS, PC A06/MF A01
50982	5:33414	NTIS, PC A02/MF A01
51046	5:33690	NTIS, PC A06/MF A01
51092	5:33368	NTIS, PC A03/MF A01
51118	5:33387	NTIS, PC A15/MF A01
51118	5:33393	NTIS, PC A15/MF A01
51118	5:33394	NTIS, PC A15/MF A01
51118	5:33395	NTIS, PC A15/MF A01
51118	5:33396	NTIS, PC A15/MF A01
51118	5:33397	NTIS, PC A15/MF A01
51118	5:33398	NTIS, PC A15/MF A01
51118	5:33399	NTIS, PC A15/MF A01
51118	5:33400	NTIS, PC A15/MF A01
51118	5:33401	NTIS, PC A15/MF A01
51118	5:33442	NTIS, PC A15/MF A01
51118	5:34115	NTIS, PC A15/MF A01
51118	5:34196	NTIS, PC A15/MF A01
51118	5:34197	NTIS, PC A15/MF A01
51118	5:34203	NTIS, PC A15/MF A01
51118	5:34205	NTIS, PC A15/MF A01
51118	5:34206	NTIS, PC A15/MF A01

Report No.	Abstract No.	Availability
51118	5:34207	NTIS, PC A15/MF A01
51118	5:34208	NTIS, PC A15/MF A01
51118	5:34209	NTIS, PC A15/MF A01
51118	5:34210	NTIS, PC A15/MF A01
51118	5:34211	NTIS, PC A15/MF A01
51118	5:34212	NTIS, PC A15/MF A01
51118	5:34213	NTIS, PC A15/MF A01
51118	5:34214	NTIS, PC A15/MF A01
51118	5:34215	NTIS, PC A15/MF A01
51118	5:34216	NTIS, PC A15/MF A01
51118	5:34217	NTIS, PC A15/MF A01
51126	5:33664	NTIS, PC A02/MF A01
51149	5:34110	NTIS, PC A03/MF A01
51161	5:34142	NTIS, PC A02/MF A01
51171	5:33773	NTIS, PC A04/MF A01
51172	5:33210	NTIS, PC A06/MF A01
51194	5:33908	NTIS, PC A05/MF A01
51199	5:33665	NTIS, PC A02/MF A01
51211	5:34163	NTIS, PC A03/MF A01
51226	5:33352	NTIS, PC A06/MF A01
CLM-P- 582	5:33631	NTIS (US Sales Only), PC A02/MF A01
CONF-740599-	(4. mineral waste utilization symposium, Chicago, IL, USA, 7-8 May 1974)	
2	5:33357	Chicago, IL; Institute of Gas Technology (1974).
CONF-7710235-	(Forum marking the 25th anniversary of the founding of Resources for the Future, Washington, DC, USA, 13 Oct 1977)	
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CONF-780295-	(International Solar Energy Society conference, London, UK, 27 Feb 1978)	
	5:33490	London, England; UK-ISES (1978).
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	5:33621	*See* IWGFR-29
CONF-780339-	(Conference on future trends in superconductive electronics, Charlottesville, VA, USA, 23-25 Mar 1978)	
	5:33961	New York, NY; American Institute of Physics (1978).
	5:33962	No. 44, 11-21(1978)
	5:33963	No. 44, 22-27(1978)
	5:33964	No. 44, 37-48(1978)
	5:33965	No. 44, 58-72(1978)
	5:33966	No. 44, 73-86(1978)
	5:33967	No. 44, 87-94(1978)
	5:33968	No. 44, 95-105(1978)
	5:33969	No. 44, 106-116(1978)
	5:33970	No. 44, 117-129(1978)
	5:33971	No. 44, 130-134(1978)
	5:33972	No. 44, 135-139(1978)
	5:33973	No. 44, 140-144(1978)
	5:33974	No. 44, 145-149(1978)
	5:33975	No. 44, 150-154(1978)
	5:33976	No. 44, 155-160(1978)
	5:33977	No. 44, 161-165(1978)
	5:33978	No. 44, 166-170(1978)
	5:33979	No. 44, 171-181(1978)
	5:33980	No. 44, 182-186(1978)
	5:33981	No. 44, 187-191(1978)
	5:33982	No. 44, 192-213(1978)
	5:33983	No. 44, 214-218(1978)
	5:33984	No. 44, 219-222(1978)
	5:33985	No. 44, 223-229(1978)
	5:33986	No. 44, 230-238(1978)
	5:33987	No. 44, 239-245(1978)
	5:33988	No. 44, 246-253(1978)
	5:33989	No. 44, 259-263(1978)
	5:33990	No. 44, 264-268(1978)
	5:33991	No. 44, 269-279(1978)
	5:33992	No. 44, 280-288(1978)
	5:33993	No. 44, 289-297(1978)
	5:33994	No. 44, 298-311(1978)
	5:33995	No. 44, 312-316(1978)
	5:33996	No. 44, 317-321(1978)
	5:33997	No. 44, 322-326(1978)
	5:33998	No. 44, 327-334(1978)
	5:33999	No. 44, 335-339(1978)
	5:34000	No. 44, 340-344(1978)
	5:34001	No. 44, 345-348(1978)
	5:34002	No. 44, 349-353(1978)
	5:34003	No. 44, 354-358(1978)
	5:34004	No. 44, 364-379(1978)
	5:34005	No. 44, 380-383(1978)
	5:34006	No. 44, 384-388(1978)
	5:34007	No. 44, 389-396(1978)
	5:34008	No. 44, 397-403(1978)
	5:34009	No. 44, 404-406(1978)
	5:34010	No. 44, 407-411(1978)
	5:34011	No. 44, 412-420(1978)
	5:34012	No. 44, 421-424(1978)
	5:34013	No. 44, 425-436(1978)
	5:34014	No. 44, 437-447(1978)
	5:34015	No. 44, 459-464(1978)
	5:34016	No. 44, 465-469(1978)
	5:34017	No. 44, 470-478(1978)
	5:34018	No. 44, 479-482(1978)
	5:34019	No. 44, 254-258(1978)
	5:34020	No. 44, 448-458(1978)
CONF-7806188-	(International symposium on risk and reliability in water resources, Waterloo, Ontario, Canada, 26-28 Jun 1978)	
(Vol.1)	5:34159	Water Resources Application, P.O. Box 2841, Littleton, CO
(Vol.2)	5:34160	Water Resources Application, P.O. Box 2841, Littleton, CO
CONF-7808125-	(22. annual symposium of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA, USA, 30-31 Aug 1978)	
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CONF-781009-	(4. US-USSR colloquium on MHD electric power generation, Washington, DC, USA, 5-6 Oct 1978)	
2	5:33746	NTIS, PC A10/MF A01
CONF-781249-	(Joint annual meeting of the Israel Nuclear Societies Ben Gurion University of the Negev, Beersheba, Israel, 28 Dec 1978)	
1	5:34184	*See* DOE/EV/03221-68
CONF-781273-	(International symposium on biological applications of soalr energy, Madurai, India, 1-5 Dec 1978)	
	5:33428	Madras, India; Madurai Kamaraj University (1980).
CONF-790259-	(Data management needs for atmospheric deposition workshop, Washington, DC, USA, 22-23 Feb 1979)	
(Summ.)	5:34122	*See* EPRI-WS-79-163
CONF-790323-	(Symposium on high spin phenomena in nuclei, Argonne, IL, USA, 15-17 Mar 1979)	
	5:34330	*See* ANL/PHY-79-4
CONF-790355-	(2. international conference on infrared physics, Zurich, Switzerland, 5-9 Mar 1979)	
	5:34031	NTIS (US Sales Only), PC A20/MF A01
CONF-790382-	(Radionuclide/trace element cycling workshop, Gaithersburg, MD, USA, 7-9 Mar 1979)	
(Absts.)	5:34164	NTIS, PC A09/MF A01
CONF-7903134-	(13. middle atlantic regional meeting of the American Chemical Society, West Long Branch, NJ, USA, 19-23 Mar 1979)	
1	5:33839	*See* DOE/NASA/1040-16
CONF-790401-	(District heating coal generation symposium, Minneapolis, MN, USA, 2-3 Apr 1979)	
	5:33758	NTIS, PC A14/MF A01
	5:33803	NTIS, PC A14/MF A01
	5:33804	NTIS, PC A14/MF A01
	5:33805	NTIS, PC A14/MF A01
	5:33806	NTIS, PC A14/MF A01
	5:33807	NTIS, PC A14/MF A01
	5:33808	NTIS, PC A14/MF A01
	5:33809	NTIS, PC A14/MF A01
	5:33810	NTIS, PC A14/MF A01
	5:33811	NTIS, PC A14/MF A01
	5:33812	NTIS, PC A14/MF A01
CONF-790445-	(Annual meeting of the institute of environmental sciences, Seattle, WA, USA, 29 Apr-2 May 1979)	
11	5:33589	*See* PNL-SA-7422
CONF-790520-	(3. international symposium on alcohol fuels technology, Asilomar, CA, USA, 28-31 May 1979)	
	5:33358	NTIS, PC A99/MF A01
	5:33359	NTIS, PC A99/MF A01

Report No.	Abstract No.	Availability
	5:33362	NTIS, PC A99/MF A01
	5:33363	NTIS, PC A99/MF A01
	5:33415	NTIS, PC A99/MF A01
	5:33416	NTIS, PC A99/MF A01
	5:33417	NTIS, PC A99/MF A01
	5:33840	NTIS, PC A99/MF A01
	5:33841	NTIS, PC A99/MF A01
	5:33842	NTIS, PC A99/MF A01
	5:33843	NTIS, PC A99/MF A01
	5:33844	NTIS, PC A99/MF A01
	5:33845	NTIS, PC A99/MF A01
	5:33846	NTIS, PC A99/MF A01
	5:33847	NTIS, PC A99/MF A01
	5:33848	NTIS, PC A99/MF A01
	5:34111	NTIS, PC A99/MF A01
CONF-7905107-	(1. workshop on ultra-relativistic nuclear collision, Berkeley, CA, USA, 21-24 May 1979)	
	5:34234	*See* LBL-8957
	5:34282	*See* LBL-8957
	5:34283	*See* LBL-8957
	5:34303	*See* LBL-8957
	5:34320	*See* LBL-8957
	5:34321	*See* LBL-8957
	5:34342	*See* LBL-8957
	5:34355	*See* LBL-8957
	5:34356	*See* LBL-8957
	5:34357	*See* LBL-8957
	5:34358	*See* LBL-8957
	5:34359	*See* LBL-8957
	5:34363	*See* LBL-8957
CONF-7905172-	(4. conference on Cooley's anemia, New York, NY, USA, 21-23 May 1979)	
1	5:34228	NTIS, PC A02/MF A01
CONF-7905177-	(Pulp and paper conference, Harrison Hot Springs, Canada, 26 May 1979)	
1	5:33793	NTIS (US Sales Only), PC A03/MF A01
CONF-790634-	(72. annual Air Pollution Control Association meeting, Cincinnati, OH, USA, 24-28 Jun 1979)	
4(Rev.)	5:33778	*See* LBL-8894(Rev.)
CONF-7906181-	(24. international meeting of the Institute of Management Science, Honolulu, HI, USA, 15 Jun 1979)	
1	5:34257	*See* PNL-SA-7417
CONF-7906185-	(Polycrystalline silicon solar cells DOE/SERI contractors meeting, Arlington, VA, USA, 14 Jun 1979)	
1	5:33405	*See* PNL-SA-7778
CONF-790752-	(Workshop on the health effects of photovoltaic technology, Upton, NY, USA, 31 Jul-2 Aug 1979)	
	5:33387	*See* BNL-51118
	5:33393	*See* BNL-51118
	5:33394	*See* BNL-51118
	5:33395	*See* BNL-51118
	5:33396	*See* BNL-51118
	5:33397	*See* BNL-51118
	5:33398	*See* BNL-51118
	5:33399	*See* BNL-51118
	5:33400	*See* BNL-51118
	5:33401	*See* BNL-51118
	5:33442	*See* BNL-51118
	5:34115	*See* BNL-51118
	5:34196	*See* BNL-51118
	5:34197	*See* BNL-51118
	5:34203	*See* BNL-51118
	5:34205	*See* BNL-51118
	5:34206	*See* BNL-51118
	5:34207	*See* BNL-51118
	5:34208	*See* BNL-51118
	5:34209	*See* BNL-51118
	5:34210	*See* BNL-51118
	5:34211	*See* BNL-51118
	5:34212	*See* BNL-51118
	5:34213	*See* BNL-51118
	5:34214	*See* BNL-51118
	5:34215	*See* BNL-51118
	5:34216	*See* BNL-51118
	5:34217	*See* BNL-51118
CONF-790787-	(Workshop on beam current limitations in storage rings, Upton, NY, USA, 16-27 Jul 1979)	
2	5:34068	*See* BNL-27971
3	5:34069	*See* BNL-27972
CONF-7908124-	(17. annual international seminar and equipment show, San Diego, CA, USA, 27-31 Aug 1979)	
1	5:34061	New Castle, DE; AENCO, Incorporated (1979).
CONF-790917-	(American Chemical Society national meeting, Washington, DC, USA, 10-14 Sep 1979)	
P3	5:33192	University Microfilms, Ann Arbor, MI, $11.00
P3	5:33193	23: No. 3, 2-9(1979)
P3	5:33194	23: No. 3, 3, 10-16(1979)
P3	5:33195	23: No. 3, 41-51(1979)
P3	5:33196	23: No. 3, 52-63(1979)
P3	5:33204	24: No. 3, 185-194(1979)
P3	5:33205	24: No. 3, 195-203(1979)
P3	5:33206	24: No. 3, 215-223(1979)
P3	5:33207	24: No. 3, 224-230(1979)
P3	5:33208	24: No. 3, 231-242(1979)
P3	5:33209	24: No. 3, 279-290(1979)
P3	5:33211	24: No. 3, 129-140(1979)
P3	5:33212	24: No. 3, 271-277(1979)
P3	5:33217	24: No. 3, 243-250(1979)
P3	5:33218	24: No. 3, 251-259(1979)
CONF-790923-	(Decontamination and decommissioning of nuclear facilities conference, Sun Valley, ID, USA, 16-19 Sep 1979)	
12	5:33627	*See* PNL-SA-8017
13	5:33318	*See* PNL-SA-8014
CONF-791037-	(IEEE nuclear science symposium, San Francisco, CA, USA, 17-19 Oct 1979)	
31	5:34081	*See* DOE/ER/05023-1
CONF-791082-	(DOE automotive technology development contractors coordination meeting, Dearborn, MI, USA, 23-25 Oct 1979)	
2	5:33819	*See* TE-4257-72-80
CONF-791085-	(Radiation accident preparedness conference, Oak Ridge, TN, USA, 19-20 Oct 1979)	
4	5:33340	*See* DPSPU-79-30-19
7	5:34187	*See* PNL-SA-8106
CONF-7910166-	(2. symposium on the Cerro Prieto Geothermal Field, Baja California, Mexico, 17-19 Oct 1979)	
14	5:33554	*See* LBL-10540
CONF-7910178-	(Load management customer participation workshop, Sacramento, CA, USA, 16 Oct 1979)	
	5:33729	Sacramento, CA; California Energy Commission (1979).
CONF-7910183-	(Workshop on regional air pollution modeling, Port Deposit, MD, USA, 29 Oct-1 Nov 1979)	
1	5:34131	*See* PNL-SA-8431
CONF-7910186-	(10. international technical meeting on air pollution modeling and its application, Rome, Italy, 21 Oct-4 Nov 1979)	
1	5:34129	*See* PNL-SA-7658
CONF-791103-	(American Nuclear Society meeting, San Francisco, CA, USA, 12-16 Nov 1979)	
81	5:34185	NTIS, PC A02/MF A01
CONF-791199-	(Conference on small-scale hydropower in the Midwest, Detroit, MI, USA, 14-15 Nov 1979)	
(Summ.)	5:33375	*See* DOE/RA/04934-05
CONF-7911103-	(1. InterAmerican conference on renewable sources of energy, New Orleans, LA, USA, 25-29 Nov 1979)	
1	5:33419	TIC
CONF-7911105-	(Workshop on toxic substances in precipitation, Jekyll Island, GA, USA, 13-16 Nov 1979)	
1	5:34130	*See* PNL-SA-8170
CONF-791201-	(4. IRIA international symposium on computing methods in applied science and engineering, Versailles, France, 10-14 Dec 1979)	
4	5:34400	*See* COO-3077-164
CONF-791209-	(Institute of Gas Technology symposium, Atlanta, GA, USA, 3-6 Dec 1979)	
	5:33287	$60.00
CONF-791233-	(Conference on thermal performance of the exterior envelopes of buildings, Orlando, FL, USA, 3-5 Dec 1979)	
5	5:33779	*See* LBL-9270
7	5:33766	*See* LBL-9821
8	5:33765	*See* LBL-9803

Report No.	Abstract No.	Availability
CONF-800123-		(Orbis Scientiae, Coral Gables, FL, USA, 14-17 Jan 1980)
4	5:34280	*See* SLAC-PUB-2532
CONF-800207-		(SPIE meeting, North Hollywood, CA, USA, 4-7 Feb 1980)
4	5:33863	*See* PNL-SA-8295
CONF-800208-		(Tropical meeting on inertial confinement fusion, San Diego, CA, USA, 26-28 Feb 1980)
15	5:33343	*See* UCRL-83398
16	5:33344	*See* UCRL-83399
CONF-800210-		(IEEE Region 6 conference, San Diego, CA, USA, 20-22 Feb 1980)
4	5:33759	NTIS, PC A02/MF A01
CONF-800212-		(7. WATTec annual energy conference and exhibition during National Engineers' week, Knoxville, TN, USA, 20-22 Feb 1980)
	5:33667	NTIS, PC A05/MF A01
	5:33668	NTIS, PC A05/MF A01
	5:33669	NTIS, PC A05/MF A01
	5:33670	NTIS, PC A05/MF A01
	5:33678	NTIS, PC A05/MF A01
	5:33688	NTIS, PC A05/MF A01
	5:33689	NTIS, PC A05/MF A01
	5:33695	NTIS, PC A05/MF A01
CONF-800250-		(Workshop on evaluated systems for renewable energy systems, Golden, CO, USA, 20-22 Feb 1980)
	5:33744	*See* SERI/TP-744-661
CONF-800303-		(179. national meeting of the American Chemical Society, Houston, TX, USA, 23-28 Mar 1980)
P3	5:33174	Univ. Microfilms, Ann Arbor, MI, $8.00
P3	5:33179	25: No. 2, 153-164(1979)
P3	5:33181	25: No. 2, 101-118(1979)
P3	5:33190	25: No. 2, 54-70(1979)
P3	5:33191	25: No. 2, 119-126(1979)
P3	5:33203	25: No. 2, 27-42(1979)
P3	5:33216	25: No. 2, 128-137(1979)
P3	5:33264	25: No. 2, 146-152(1979)
P4	5:33202	25: No. 1, 1-7(1979)
CONF-800313-		(Waste management conference, Tucson, AZ, USA, 10 Mar 1980)
9	5:33319	*See* PNL-SA-8414
CONF-800334-		(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)
20	5:34218	*See* PNL-SA-8202
CONF-800350-		(Conference on the role of tropical forests on the world carbon cycle, Rio Piedras, Puerto Rico, 19 Mar 1980)
	5:34148	NTIS, PC A08/MF A01
CONF-800352-		(7. energy technology conference and exposition, Washington, DC, USA, 24-26 Mar 1980)
5	5:33815	New Castle, DE; AENCO, Inc. (1980).
CONF-800370-		(Supernova type I workshop, Austin, TX, USA, 17-19 Mar 1980)
2	5:34233	*See* LA-UR-80-2197
CONF-800374-		(15. Rencontre de Moriond, Les Arcs, France, 9-21 Mar 1980)
5	5:34085	*See* SLAC-PUB-2526
6	5:34279	*See* SLAC-PUB-2517
7	5:34291	*See* SLAC-PUB-2510
CONF-800394-		(59. annual convention of the Gas Processors Association, Houston, TX, USA, 17 May-19 Mar 1980)
	5:33279	Tulsa, OK; Gas Processors Association (1980).
CONF-800396-		(National symposium on recycling of residues of agriculture and industry, Ludhiana, India, Mar 1980)
1	5:33791	NTIS (US Sales only), PC A02/MF A01
CONF-800398-		(Specialist meeting on assessment of radon and daughter exposure and related biological effects, Rome, Italy, 3-8 Mar 1980)
1	5:34192	*See* PNL-SA-8291
CONF-800402-		(International symposium on the properties and applications of metal hydrides, Colorado Springs, CO, USA, 7-11 Apr 1980)
15	5:34372	*See* SAND-79-1540C
CONF-800419-		(5. symposium on automotive propulsion systems, Dearborn, MI, USA, 14-18 Apr 1980)
5	5:33849	NTIS, PC A02/MF A01
CONF-800425-		(13. oil shale symposium, Golden, CO, USA, 16-18 Apr 1980)
6	5:33299	*See* LBL-11072
CONF-800427-		(Tritium technology in fission, fusion, and isotopic applications, Dayton, OH, USA, 29 Apr-1 May 1980)
18	5:34023	*See* UCRL-84318
CONF-800428-		(6. international conference on fluidized bed combustion, Atlanta, GA, USA, 9-11 Apr 1980)
7	5:33237	NTIS, PC A02/MF A01
CONF-800439-		(International conference on metallurgical coatings, San Diego, CA, USA, 21-25 Apr 1980)
12	5:33852	*See* HEDL-SA-2189
CONF-800455-		(4. international conference on plasma surface interactions in controlled fusion devices, Garmisch, F.R. Germany, 21-25 Apr 1980)
18	5:34398	*See* PPPL-1688
CONF-800482-		(Bio-energy world congress and exposition, Atlanta, GA, USA, 21-24 Apr 1980)
3	5:33433	St. Paul, MN; University of Minnesota (1980).
CONF-800484-		(Reversed field pinch theory workshop, Los Alamos, NM, USA, 28 Apr-2 May 1980)
5	5:34414	*See* LA-UR-80-2406
6	5:34402	*See* LA-UR-80-2043
CONF-800485-		(Workshop on the predictive value of in vitro short-term screening tests in carcinogenicity evaluation, Koevordon, Netherlands, 28-30 Apr 1980)
1	5:34200	NTIS, PC A02/MF A01
CONF-800499-		(International workshop on gamma-gamma collisions, Amiens, France, 8-12 Apr 1980)
2	5:34288	*See* SLAC-PUB-2503
CONF-8004102-		(6. international conference on experimental meson spectroscopy, Upton, NY, USA, 25-26 Apr 1980)
1	5:34284	*See* BNL-28057
2	5:34276	*See* SLAC-PUB-2519
CONF-8004105-		(International symposium on grain boundary phenomena in electronic ceramics, Chicago, IL, USA, 29 Apr 1980)
1	5:34368	*See* DOE/ER/01198-1311
CONF-8004106-		(International quantum electronics conference, Boston, MA, USA, 2- Apr 1980)
1(Rev.1)	5:34365	*See* UCRL-84259(Rev.1)
CONF-8004108-		(International symposium on browse in Africa, Addis Abba, Ethiopia, Apr 1980)
1	5:34180	NTIS, PC A03/MF A01
CONF-8004110-		(DOE research conference on CO/sub 2/, Washington, DC, USA, 24-25 Apr 1980)
1	5:34134	*See* UCRL-84677
CONF-8004111-		(Radionuclide transport modeling workshop, Fort Collins, CO, USA, 23 Apr 1980)
1	5:34135	NTIS, PC A02/MF A01
CONF-800551-		(Symposium on neutron cross sections from 10 - 50 MeV, Upton, NY, USA, 12-14 May 1980)
21	5:34082	*See* HEDL-SA-2123-FP
CONF-800587-		(International cryogenic materials conference, Upton, NY, USA, 28-29 May 1980)
5	5:34380	*See* LBL-10761
CONF-8005100-		(International microwave symposium, Washington, DC, USA, 28-30 May 1980)
1	5:34059	*See* SLAC-PUB-2480
CONF-8005102-		(Seminar on the beam-beam interaction, Stanford, CA, USA, 22-23 May 1980)
1	5:34070	*See* BNL-28033
CONF-8005104-		(International conference on superconducting quantum interference devices, Berlin, F.R. Germany, 5-9 May 1980)
1	5:34381	*See* LBL-11055
CONF-8005107-		(Alternate waste form information workshop, Gatlinburg, TN, USA, 13-15 May 1980)
1	5:33310	*See* HEDL-SA-2138
CONF-800607-		(American Nuclear Society annual meeting, Las Vegas, NV, USA, 8-13 Jun 1980)
83	5:33619	*See* HEDL-SA-2112-FD
84	5:34436	*See* HEDL-SA-2019-FP
CONF-800648-		(GCFRP program technical review meeting, San Diego, CA, USA, 4-6 Jun 1980)
12	5:33618	*See* GA-A-15932

Report No.	Abstract No.	Availability
CONF-800655-		(21. annual meeting of the Institute of Nuclear Materials Management, Palm Beach, FL, USA, 30 Jun-2 Jul 1980)
30	5:33313	*See* DP-MS-80-73
CONF-800674-		(5. workshop on current problems in high energy particle theory, Bad Honnef, F.R. Germany, 2-4 Jun 1980)
2	5:34302	*See* FERMILAB-CONF-80/69
CONF-800684-		(International conference on experimentation at LEP, Uppsala, Sweden, 16-20 Jun 1980)
2	5:34094	*See* COO-3071-245
4	5:34093	*See* BNL-28132
6	5:34080	*See* BNL-28214
CONF-800688-		(5. European symposium on nucleon-antinucleon interactions, Bressanone, Italy, Jun 1980)
2	5:34270	*See* BNL-28142
CONF-800695-		(1. BAIL conference, Dublin, Ireland, 3-6 Jun 1980)
1	5:33247	*See* LBL-11086
CONF-800699-		(Elliptic problem solvers conference, Santa Fe, NM, USA, 30 Jun-2 Jul 1980)
2	5:34445	*See* LA-UR-80-2342
3	5:34446	*See* LA-UR-80-2343
CONF-8006100-		(Symposia on legumes, Bloomington, IN, USA, Jun 1980)
1	5:33420	NTIS, PC A03/MF A01
CONF-8006101-		(Symposium on new and underutilized biological resources, Medellin, Colombia, 6-9 Jun 1980)
1	5:34143	NTIS, PC A02/MF A01
CONF-8006108-		(11. international symposium on multiparticle dynamics, Bruges, Belgium, 22-27 Jun 1980)
2	5:34293	*See* LA-UR-80-2235
CONF-8006109-		(International conference on the evaluation in science and technology theory and practice, Dubrovnik, Yugoslavia, 30 Jun-4 Jul 1980)
1	5:34392	*See* BNL-28145
CONF-8006110-		(1. international symposium on toxic blue-green algae, Dayton, OH, USA, 29 Jun-2 Jul 1980)
1	5:34156	*See* BNL-28136
CONF-8006115-		(Iowa solar operational results conference, Des Moines, IA, USA, 20 Jun 1980)
1	5:33474	*See* IS-M-290
2	5:33473	*See* IS-M-286
CONF-800707-		(8. international conference on plasma physics and controlled nuclear fusion research, Brussels, Belgium, 1-10 Jul 1980)
18	5:34399	*See* GA-A-15963
19	5:34435	*See* DOE/ET/53051-6
CONF-800709-		(Seminar on high-energy nuclear interactions and properties of dense nuclear matter, Hakone, Japan, 7-11 Jul 1980)
3	5:34360	*See* LBL-11123
CONF-800714-		(NATO advanced study institute on fast reactions in energetic systems, Ioannina, Greece, 6-19 Jul 1980)
2	5:34106	*See* UCRL-84587
CONF-800719-		(International symposium of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA, USA, 28 Jul-1 Aug 1980)
11	5:34097	NTIS, PC A02/MF A01
CONF-800724-		(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)
7	5:34289	*See* FERMILAB-CONF-80/63-THY
8	5:34294	*See* SLAC-PUB-2505
12	5:34271	*See* COO-3071-248
14	5:34272	*See* DOE/ER/02232-88
15	5:34281	*See* FERMILAB-CONF-80/57-EXP
16	5:34273	*See* FERMILAB-CONF-80/56-EXP
20	5:34290	*See* FERMILAB-CONF-80/66-THY
21	5:34301	*See* FERMILAB-CONF-80/68-THY
CONF-800735-		(Healthy Physics Society summer school, Seattle, WA, USA, 14-18 Jul 1980)
2	5:34088	*See* HEDL-SA-2041
CONF-800740-		(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)
6	5:34086	*See* LA-UR-80-1946
7	5:34078	*See* LA-UR-80-1945
8	5:34074	*See* LA-UR-80-1855
9	5:34083	*See* LA-UR-80-1856
12	5:34071	*See* BNL-28131
13	5:34075	*See* SLAC-PUB-2548
CONF-800742-		(2. international congress on toxicology, Brussels, Belgium, 6-11 Jul 1980)
2	5:34178	*See* UCLA-12-1261
CONF-800743-		(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)
9	5:33321	*See* RHO-SA-174
CONF-800747-		(Review group conference on advanced instrumentation for reactor safety research, Oak Ridge, TN, USA, 29-31 Jul 1980)
3	5:34087	NTIS, PC A02/MF A01
4	5:33632	NTIS, PC A02/MF A01
5	5:33610	NTIS, PC A02/MF A01
CONF-800751-		(Workshop on thermomechanical-hydrochemical modeling for hardrock waste repository, Bereley, CA, USA, 29-31 Jul 1980)
3	5:33338	*See* UCRL-84613
CONF-800767-		(DARPA/AFML review of progress in quantitative NDE conference, La Jolla, CA, USA, 14-17 Jul 1980)
1	5:34047	*See* LA-UR-80-2040
2	5:34046	*See* LA-UR-80-2039
CONF-800802-		(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)
12	5:33307	NTIS, PC A02/MF A01
15	5:33222	*See* IS-M-289
CONF-800804-		(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)
25	5:33293	*See* SAND-80-1873C
CONF-800806-		(15. intersociety energy conversion engineering conference, Seattle, WA, USA, 18-22 Aug 1980)
38	5:33822	*See* DOE/NASA/1040-17
CONF-800808-		(7. international conference on raman spectroscopy, Ottawa, Canada, 4-9 Aug 1980)
6	5:33929	NTIS, PC A02/MF A01
CONF-800809-		(18. combustion symposium, Waterloo, Canada, 17-22 Aug 1980)
6	5:34125	*See* LBL-11237
CONF-800814-		(180. American Chemical Society meeting/2. chemical congress of the North American Continent, Las Vegas, NV, USA, 24-29 Aug 1980)
7	5:33418	NTIS, PC A02/MF A01
9	5:33214	NTIS, PC A02/MF A01
11	5:34116	NTIS, PC A02/MF A01
12	5:33315	NTIS, PC A03/MF A01
13	5:33240	NTIS, PC A02/MF A01
14	5:33928	*See* LA-UR-80-2414
CONF-800819-		(Summer computer simulation conference, Seattle, WA, USA, 25-27 Aug 1980)
2	5:34166	NTIS, PC A02/MF A01
CONF-800820-		(American Statistical Society meeting, Houston, TX, USA, 11-14 Aug 1980)
5	5:34457	NTIS, PC A03/MF A01
6	5:34442	NTIS, PC A02/MF A01
CONF-800824-		(5. international symposium on polarization phenomena in nuclear physics, Santa Fe, NM, USA, 11-15 Aug 1980)
10	5:34325	*See* LA-UR-80-1925
13	5:34312	*See* LA-UR-80-1919
14	5:34076	*See* LA-UR-80-1905
15	5:34328	*See* LA-UR-80-1977
16	5:34274	*See* LA-UR-80-1976
17	5:34366	*See* LA-UR-80-1933
18	5:34095	*See* LA-UR-80-1943
20	5:34319	*See* LA-UR-80-2427
CONF-800827-		(3. international conference on photochemical conversion and storage of solar energy, Golden, CO, USA, 3-8 Aug 1980)
3	5:34167	*See* BNL-28030
CONF-800829-		(International conference on the few body problems, Eugene, OR, USA, 17-23 Aug 1980)
4	5:34306	NTIS, PC A02/MF A01
5	5:34307	NTIS, PC A02/MF A01
6	5:34311	NTIS, PC A02/MF A01
7	5:34308	NTIS, PC A02/MF A01

Report No.	Abstract No.	Availability
CONF-800835-		(Symposium on energy modeling III: dealing with energy uncertainty, Chicago, IL, USA, 4-8 Aug 1980)
2	5:33774	NTIS, PC A02/MF A01
CONF-800837-		(Rocky Mountain conference, Denver, CO, USA, 11-14 Aug 1980)
1	5:33925	*See* DP-MS-80-17
CONF-800845-		(Annual meeting of the American Political Science Association, Washington, DC, USA, 28-31 Aug 1980)
1	5:33675	*See* SAND-80-1871C
CONF-800846-		(US-Greece symposium on mixed mode crack propagation, Athens, Greece, 18-22 Aug 1980)
1	5:33955	*See* SAND-80-1877C
CONF-800849-		(US environmental protection agency workshop on environmental risk assessment of synfuels, Alexandria, VA, USA, 25-27 Aug 1980)
1	5:33681	*See* UCRL-84839
CONF-800850-		(International conference on effects of hydrogen on materials, Jackson Lake Lodge, WY, USA, 26-31 Aug 1980)
1	5:33861	*See* DP-MS-79-73
CONF-800855-		(2. international topical meeting on muon spin rotation, Vancouver, BC, Canada, Aug 1980)
2	5:34253	*See* LA-UR-80-2375
3	5:34255	*See* LA-UR-80-2377
4	5:34254	*See* LA-UR-80-2376
5	5:34252	*See* LA-UR-80-2374
6	5:34251	*See* LA-UR-80-2373
7	5:34371	*See* LA-UR-80-2372
8	5:34275	*See* LA-UR-80-2371
9	5:34249	*See* BNL-28196
CONF-800908-		(6. international conference on crystal growth, Moscow, USSR, Sep 1980)
1	5:33870	*See* SAND-80-1038C
CONF-800913-		(International conference: security through science and engineering, Berlin, F.R. Germany, 23-26 Sep 1980)
2	5:34021	*See* LA-UR-80-1617
CONF-800919-		(7. world conference on earthquake engineering, Istanbul, Turkey, 8-13 Sep 1980)
1	5:33634	*See* UCRL-81944
CONF-800920-		(Geothermal Resource Council annual meeting, Salt Lake City, UT, USA, 9-11 Sep 1980)
20	5:33575	*See* UCRL-84489
26	5:33569	*See* LBL-11107
CONF-800928-		(8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface, Cannes, France, 22-26 Sep 1980)
1	5:34079	*See* BNL-27767
CONF-800932-		(2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas, Como, Italy, 3-12 Sep 1980)
2	5:34395	*See* PPPL-1692
CONF-800933-		(18. international annual meeting of the Society of Nuclear Medicine, Nurnberg, F.R. Germany, 9-12 Sep 1980)
1	5:34175	*See* UCLA-12-1257
2	5:34176	*See* UCLA-12-1258
CONF-800936-		(Seminar on the application of high magnetic fields in physics and semiconductors and magnetic materials, Hakone, Japan, 10-13 Sep 1980)
1	5:34370	*See* LA-UR-80-2182
CONF-800937-		(International symposium on medical radionuclide imaging, Heidelburg, F.R. Germany, 1-5 Sep 1980)
2	5:34173	*See* DOE/EV/10343-4
CONF-800938-		(International executive conference on nonproliferation and safeguards, Mexico City, Mexico, 7-10 Sep 1980)
1	5:33341	*See* AGNS-35900-Conf-85
CONF-800940-		(15. international conference on the physics of semiconductors, Kyoto, Japan, 1-5 Sep 1980)
1	5:34373	*See* SAND-80-1697C
CONF-800941-		(19. DOD explosives safety seminar, Los Angeles, CA, USA, 9-11 Sep 1980)
2	5:34102	*See* MLM-2762(OP)
CONF-800943-		(National topical meeting of fuel cycles for the 80's, Gatlinburg, TN, USA, 29 Sep-2 Oct 1980)
5	5:33306	*See* AGNS-35900-CONF-71
CONF-800944-		(7. symposium on microdosimetry, Oxford, UK, 8-12 Sep 1980)
1	5:34367	*See* BNL-28157
CONF-800948-		(2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas, Grenoble, France, Sep 1980)
1	5:34415	*See* LA-UR-80-2500
CONF-800950-		(11. symposium on fusion technology, Oxford, UK, 15-19 Sep 1980)
1	5:34423	*See* LA-UR-80-2499
CONF-800953-		(Annual meeting of the Fine Particle Society, Washington, DC, USA, 16-18 Sep 1980)
1	5:34124	*See* IS-M-285
CONF-801003-		(Symposium on computational methods in nonlinear structural and solid mechanics, Washington, DC, USA, 6-8 Oct 1980)
3	5:34225	*See* LA-UR-79-3016
4	5:33957	*See* UCRL-83559
CONF-801004-		(Computer performance evaluation users group conference, Orlando, FL, USA, Oct 1980)
1	5:34444	*See* LA-UR-80-1185
CONF-801005-		(International conference on circuits and computers, Port Chester, NY, USA, 1-3 Oct 1980)
1	5:34058	*See* SAND-80-0420C
CONF-801007-		(1980 fall conference of the Association of System 2000 Users for Technical Exchange (ASTUTE), San Francisco, CA, USA, 6-8 Oct 1980)
1	5:34460	*See* SAND-80-1252C
CONF-801008-		(43. annual meeting of the American Society for Information Sciences, Anaheim, CA, USA, 5-10 Oct 1980)
1	5:34458	*See* LBL-10437
CONF-801009-		(6. international conference on very large data bases, Montreal, Canada, 1-3 Oct 1980)
2	5:34459	*See* LBL-10648
CONF-801010-		(12. National Society for the Advancement of Materials and Process Engineering technical conference, Seattle, WA, USA, 7-9 Oct 1980)
1	5:33911	*See* UCRL-83783
2	5:33909	*See* UCRL-83875
CONF-801011-		(4. ANS topical meeting on the technology of controlled nuclear fusion, King of Prussia, PA, USA, 14-17 Oct 1980)
1	5:34418	NTIS, PC A02/MF A01
2	5:34416	*See* LBL-11141
CONF-801014-		(Instrument Society of America conference, Houston, TX, USA, 20-23 Oct 1980)
1	5:33577	NTIS, PC A02/MF A01
CONF-801015-		(5. international clean air congress, Buenos Aires, Argentina, 20-26 Oct 1980)
1	5:34141	*See* LA-UR-80-1753
CONF-801016-		(5. national passive solar conference, Amherst, MA, USA, 19-26 Oct 1980)
1	5:33475	*See* LA-UR-80-1669
2	5:33445	*See* DOE/ET/20279-100
3	5:33477	*See* LA-UR-80-2236
5	5:33545	*See* LA-UR-80-2429
7	5:33479	*See* LA-UR-80-2268
9	5:33478	*See* LA-UR-80-2266
10	5:33519	*See* LA-UR-80-2329
11	5:33481	*See* LA-UR-80-2330
12	5:33476	*See* LA-UR-80-2231
13	5:33480	*See* LA-UR-80-2328
CONF-801017-		(IEEE computer society meeting, LCN-V, Minneapolis, MN, USA, 6-7 Oct 1980)
1	5:34452	*See* UCRL-84446
CONF-801019-		(1. International Energy Agency symposium of the air infiltration centre, Windsor, UK, 6-8 Oct 1980)
1	5:33780	*See* LBL-10705
CONF-801020-		(Marine technology conference, Washington, DC, USA, 6-8 Oct 1980)
1	5:33335	*See* SAND-80-1533C
2	5:33334	*See* SAND-80-0312C
3	5:33336	*See* SAND-80-1606C
CONF-801021-		(ASNT fall conference, Houston, TX, USA, 6-9 Oct 1980)
1	5:33952	*See* SAND-80-1380C
2	5:34048	*See* SAND-80-8733
3	5:33851	NTIS, PC A02/MF A01
CONF-801022-		(Flywheel technology symposium, Scottsdale, AZ, USA, 19-24 Oct 1980)

Report No.	Abstract No.	Availability
1	5:33639	*See* Y/DX-135
2	5:33636	*See* COO-4094-91
3	5:33637	*See* DOE/ET/20279-102
CONF-801024-	(ISHM annual meeting, New York, NY, USA, 20 Oct 1980)	
1	5:33565	*See* SAND-80-0444C
2	5:34053	*See* BDX-613-2478
CONF-801025-	(6. international symposium on transport of dangerous goods by sea and inland waterways, Tokyo, Japan, 13-17 Oct 1980)	
1	5:34161	*See* BNL-28123
CONF-801026-	(ANS workshop on power plant security, Chicago, IL, USA, 5-8 Oct 1980)	
1	5:33612	*See* SAND-80-1428C
CONF-801027-	(4. biennial cube symposium, Livermore, CA, USA, 22-24 Oct 1980)	
1	5:34034	*See* UCRL-84655
CONF-801028-	(20. joint AICHE-IMIQ meeting, Acapulco, Mexico, 15-17 Oct 1980)	
1	5:33354	*See* GA-A-15935
CONF-801030-	(4. international symposium on alcohol fuels technology, Sao Paulo, Brazil, 5-8 Oct 1980)	
1	5:33432	*See* UCRL-84136
CONF-801031-	(Plating on difficult to plate metals symposium, New Orleans, LA, USA, 30-31 Oct 1980)	
1	5:33871	*See* UCRL-84440
CONF-801032-	(Stream ecology symposium, Augusta, GA, USA, 19-22 Oct 1980)	
1	5:34194	*See* DP-MS-80-37
CONF-801033-	(Shock and vibration symposium, San Diego, CA, USA, 21-23 Oct 1980)	
1	5:33951	*See* SAND-80-1315C
CONF-801034-	(33. ACS Pacific Coast meeting, San Francisco, CA, USA, 28 Oct 1980)	
1	5:33915	*See* SAND-80-1838C
CONF-801036-	(Special topical meeting - materials performance in nuclear steam generators, St Petersburg Beach, FL, USA, 6-9 Oct 1980)	
4	5:33862	*See* GEFR-SP-205
CONF-801037-	(American Vacuum Society conference, Detroit, MI, USA, 13-17 Oct 1980)	
1	5:34084	*See* SAND-80-1388C
2	5:34437	*See* UCRL-84456
CONF-801041-	(International symposium for testing and failure analysis, Los Angeles, CA, USA, 27 Oct 1980)	
1	5:33402	*See* DOE/ET/20279-101
CONF-801043-	(NACE meeting, El Paso, TX, USA, 28-30 Oct 1980)	
1	5:33323	*See* DP-MS-80-47
CONF-801045-	(DOE statistical symposium, Berkeley, CA, USA, 29-31 Oct 1980)	
1	5:33736	*See* LA-UR-80-2354
CONF-801047-	(Annual contractors review meeting for the Department of Energy's Office of Advanced Conservation Technologies, Washington, DC, USA, 13-16 Oct 1980)	
1	5:33355	*See* LA-UR-80-2400
CONF-801050-	(Subsurface contributions to steam flow conference, Durham, NH, USA, 5-9 Oct 1980)	
1	5:34220	*See* LBL-11178
CONF-801107-	(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)	
6	5:33629	NTIS, PC A02/MF A01
CONF-801114-	(Symposium on plumes and visibility, Grand Canyon, AZ, USA, 10-14 Nov 1980)	
2	5:34133	*See* UCRL-84339
CONS-		
3122-T2	5:33602	NTIS, PC A06/MF A01
COO-		
1300-45	5:34170	NTIS, PC A02/MF A01
1340-68(Draft)	5:34157	NTIS, PC A06/MF A01
1340-75	5:34112	NTIS, PC A05/MF A01
1340-76	5:34113	NTIS, PC A05/MF A01
2387-117	5:34433	NTIS, PC A11/MF A01
2387-118	5:34408	NTIS, PC A06/MF A01
2718-8	5:34256	NTIS, PC A02/MF A01
2975-43	5:33857	NTIS, PC A05/MF A01
2978-4	5:34299	NTIS, PC A02/MF A01
3071-245	5:34094	NTIS, PC A02/MF A01
3071-248	5:34271	NTIS, PC A02/MF A01
3077-162	5:33942	NTIS, PC A04/MF A01
3077-163	5:34172	NTIS, PC A03/MF A01
3077-164	5:34400	NTIS, PC A03/MF A01
4094-61	5:33443	NTIS, PC A03/MF A01
4094-90	5:33444	NTIS, PC A06/MF A01
4094-91	5:33636	NTIS, PC A02/MF A01
4955-1	5:33286	NTIS, PC A04/MF A01
CUERS-Report-		
8	5:33691	Southern Illinois University, Edwardsville, IL
10	5:33797	Center for Urban and Environmental Research and Services, Southern Illinois Univ., Edwardsville, IL
DOE/AL/10563-		
T4	5:33576	NTIS, PC A05/MF A01
T5	5:33550	NTIS, PC A04/MF A01
DOE/BC/10003-		
10	5:33285	NTIS, PC A04/MF A01
DOE/BC/20001-		
6	5:33243	NTIS, PC A10/MF A01
DOE/BC/20009-		
8	5:33244	NTIS, PC A13/MF A01
DOE/CEA/BMFT-		
13	5:33615	NTIS (US Sales Only), PC A04/MF A01
DOE/CH/00178-		
T5	5:33421	NTIS, PC A02/MF A01
DOE/CS-		
0127/1	5:33461	NTIS, PC A16/MF A01
0155	5:33376	NTIS, PC A15/MF A01
0178(Rev.1)	5:33834	NTIS, PC A02/MF A01
DOE/CS/05438-		
T1(Vol.1)	5:33787	NTIS, PC A02/MF A01
T1(Vol.2)	5:33788	NTIS, PC A13/MF A01
DOE/CS/10510-		
T9	5:33514	NTIS, PC A04/MF A01
T10	5:33515	NTIS, PC A04/MF A01
T11	5:33516	NTIS, PC A10/MF A01
T12	5:33517	NTIS, PC A09/MF A01
DOE/CS/20258-		
2	5:33671	NTIS, PC A04/MF A01
2	5:33692	NTIS, PC A04/MF A01
2	5:33693	NTIS, PC A04/MF A01
2	5:33694	NTIS, PC A04/MF A01
3	5:33710	NTIS, PC A02/MF A01
DOE/CS/24216-		
1	5:33800	NTIS, PC A04/MF A01
DOE/CS/30108-		
T2	5:33462	NTIS, PC A02/MF A01
DOE/CS/30218-		
1	5:33518	NTIS, PC A02/MF A01
DOE/CS/30377-		
1	5:33463	NTIS, PC A04/MF A01
DOE/CS/34412-		
16	5:33464	NTIS, PC A07/MF A01
DOE/CS/35363-		
T1	5:33465	NTIS, PC A09/MF A01
DOE/CS/35760-		
T1	5:33641	NTIS, PC A04/MF A01
DOE/CS/40031-		
T1	5:33794	NTIS, PC A04/MF A01
DOE/DP/04515-		
1	5:34150	NTIS, PC A02/MF A01
DOE/DP/40050-		
9	5:33912	NTIS, PC A12/MF A01
DOE/EA-		
0061	5:33269	NTIS, PC A06/MF A01
DOE/EDP-		
0056	5:34136	NTIS, PC A03/MF A01
DOE/EG/34135-		
10	5:33466	NTIS, PC A02/MF A01
DOE/EI/10553-		
T1	5:33672	NTIS, PC A06/MF A01
DOE/EIA-		
0010/3	5:33731	NTIS, PC A02/MF A01
0049/78	5:33732	NTIS, PC A04/MF A01
0049(79)	5:33733	NTIS, PC A04/MF A01
0057/9(79)	5:33711	NTIS, PC A03/MF A01
0117/78	5:33265	NTIS, PC A02/MF A01
0118(78)	5:33229	NTIS, PC A05/MF A01
0119(77)	5:33230	NTIS, PC A03/MF A01
0173(79)3	5:33696	NTIS, PC A16/MF A01
0181	5:33757	NTIS, PC A02/MF A01
0181/2	5:33697	NTIS, PC A07/MF A01
0201/12	5:34140	NTIS, PC A04/MF A01
DOE/EIS-		
0066	5:33599	NTIS, PC A25/MF A01
DOE/ER-		
0066	5:34269	NTIS, PC A04/MF A01

Report No.	Abstract No.	Availability
0070	5:34394	NTIS, PC A05/MF A01
0071	5:34219	NTIS, PC A05/MF A01
DOE/ER/01198-134	5:33902	NTIS, PC A07/MF A01
1311	5:34368	NTIS, PC A02/MF A01
T1	5:34263	NTIS, PC A05/MF A01
DOE/ER/01569-146	5:34377	NTIS, PC A02/MF A01
147	5:34378	NTIS, PC A03/MF A01
149	5:34375	NTIS, PC A09/MF A01
DOE/ER/02232-88	5:34272	NTIS, PC A02/MF A01
DOE/ER/03072-T2	5:34268	NTIS, PC A02/MF A01
DOE/ER/03992-392	5:34300	NTIS, PC A05/MF A01
DOE/ER/05023-1	5:34081	NTIS, PC A03/MF A01
DOE/ER/05246-4	5:33885	NTIS, PC A08/MF A01
DOE/ER/10389-1	5:33858	NTIS, PC A03/MF A01
DOE/ET/00222-4	5:34201	NTIS, PC A03/MF A01
DOE/ET/10023-T6	5:33231	NTIS, PC A02/MF A01
DOE/ET/10254-82	5:33182	NTIS, PC A02/MF A01
DOE/ET/10533-9	5:33219	NTIS, PC A02/MF A01
DOE/ET/10815-T2	5:33745	NTIS, PC A02/MF A01
DOE/ET/11300-	5:33749	NTIS, PC A05/MF A01
1	5:33750	NTIS, PC A15/MF A01
T1	5:33751	NTIS, PC A04/MF A01
T2	5:33752	NTIS, PC A05/MF A01
T3	5:33753	NTIS, PC A02/MF A01
DOE/ET/11320-T1	5:33755	NTIS, PC A07/MF A01
DOE/ET/11328-T1	5:33198	NTIS, PC A06/MF A01
DOE/ET/12065-26	5:33245	NTIS, PC A08/MF A01
DOE/ET/12276-T1	5:33241	NTIS, PC A08/MF A01
DOE/ET/13381-T1	5:33199	NTIS, PC A02/MF A01
T2	5:33200	NTIS, PC A02/MF A01
DOE/ET/13513-T1	5:33859	NTIS, PC A03/MF A01
T2	5:33860	NTIS, PC A02/MF A01
DOE/ET/14815-12	5:33183	NTIS, PC A02/MF A01
DOE/ET/14858-2	5:33361	NTIS, PC A05/MF A01
DOE/ET/20049-T1	5:33422	NTIS, PC A02/MF A01
DOE/ET/20090-4	5:33384	NTIS, PC A02/MF A01
DOE/ET/20174-1	5:33381	NTIS, PC A12/MF A01
DOE/ET/20279-100	5:33445	NTIS, PC A02/MF A01
101	5:33402	NTIS, PC A02/MF A01
102	5:33637	NTIS, PC A02/MF A01
DOE/ET/20593-T1	5:33423	NTIS, PC A02/MF A01
DOE/ET/21002-2	5:33458	NTIS, PC A07/MF A01
DOE/ET/26934-1	5:33594	NTIS, PC A08/MF A01
DOE/ET/27228-T1	5:33578	NTIS, PC A14/MF A01
DOE/ET/28392-41	5:33551	NTIS, PC A03/MF A01
42	5:33555	NTIS, PC A05/MF A01
43	5:33559	NTIS, PC A06/MF A01
44	5:33552	NTIS, PC A03/MF A01
46	5:33560	NTIS, PC A05/MF A01
DOE/ET/28434-T1	5:33581	NTIS, PC A12/MF A01
DOE/ET/29185-17	5:33608	NTIS, PC A02/MF A01
DOE/ET/34209-T1	5:33611	NTIS, PC A07/MF A01
DOE/ET/37240-72	5:33616	NTIS, PC A05/MF A01
DOE/ET/52022-5	5:34419	NTIS, PC A04/MF A01
DOE/ET/53004-1	5:34397	NTIS, PC A03/MF A01
DOE/ET/53036-17	5:34401	NTIS, PC A03/MF A01
DOE/ET/53051-5	5:34434	NTIS, PC A03/MF A01
6	5:34435	NTIS, PC A02/MF A01
DOE/EV/00637-9	5:34181	NTIS, PC A03/MF A01
DOE/EV/00641-34	5:34144	NTIS, PC A02/MF A01
37	5:34149	NTIS, PC A03/MF A01
38	5:34171	NTIS, PC A02/MF A01
41	5:34182	NTIS, PC A03/MF A01
42	5:34117	NTIS, PC A02/MF A01
DOE/EV/02814-1	5:34169	NTIS, PC A02/MF A01
DOE/EV/03083-T1	5:34168	NTIS, PC A02/MF A01
DOE/EV/03221-67	5:33937	NTIS, PC A03/MF A01
68	5:34184	NTIS, PC A02/MF A01
DOE/EV/04580-T1	5:34204	NTIS, PC A05/MF A01
DOE/EV/04700-T1	5:34152	NTIS, PC A02/MF A01
DOE/EV/06020-T3	5:33270	NTIS, PC A06/MF A01
DOE/EV/10303-5	5:34191	NTIS, PC A06/MF A01
DOE/EV/10343-4	5:34173	NTIS, PC A02/MF A01
6	5:34193	NTIS, PC A04/MF A01
DOE/FE-0009	5:33171	NTIS, PC A23/MF A01
DOE/IA-0010/2	5:33663	NTIS, PC A03/MF A01
DOE/ID/12018-2	5:33566	NTIS, PC A03/MF A01
DOE/ID/12079-1	5:33563	NTIS, PC A04/MF A01
3	5:33561	NTIS, PC A02/MF A01
4	5:33553	NTIS, PC A10/MF A01
6	5:33562	NTIS, PC A04/MF A01
DOE/JPL-1060-12(Vol.1)	5:33539	NTIS, PC A02/MF A01
1060-12(Vol.2)	5:33447	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33448	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33449	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33450	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33451	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33455	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33456	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33540	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33541	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33542	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33543	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33544	NTIS, PC A12/MF A01
1060-12(Vol.2)	5:33642	NTIS, PC A12/MF A01
1060-31(Vol.2)	5:33452	NTIS, PC A07/MF A01
1060-38(Rev.1)	5:33453	NTIS, PC A06/MF A01
955492(Vol.1)	5:33353	NTIS, PC A07/MF A01
955492(Vol.2)(Pt.1)	5:33350	NTIS, PC A13/MF A01
955492(Vol.2)(Pt.2)	5:33351	NTIS, PC A11/MF A01
DOE/JPL/954873-8	5:33403	NTIS, PC A07/MF A01
DOE/JPL/955283-1	5:33835	NTIS, PC A09/MF A01
DOE/LETC-1761-2/1	5:33290	NTIS, PC A03/MF A01
DOE/METC/10866-18	5:33288	NTIS, PC A03/MF A01
DOE/METC/SP-80/8	5:33184	NTIS, PC A04/MF A01
DOE/NASA/0008-80/11	5:33821	NTIS, PC A04/MF A01
DOE/NASA/0150-80/4	5:33756	NTIS, PC A02/MF A01
DOE/NASA/1040-16	5:33839	NTIS, PC A02/MF A01
17	5:33822	NTIS, PC A02/MF A01
DOE/NASA/1062-6	5:33747	NTIS, PC A03/MF A01

Report No.	Abstract No.	Availability
DOE/NASA/CR-		
161485	5:33467	NTIS, PC A14/MF A01
161491	5:33468	NTIS, PC A05/MF A01
161507	5:33469	NTIS, PC A05/MF A01
161509	5:33470	NTIS, PC A05/MF A01
161512	5:33509	NTIS, PC A05/MF A01
161520	5:33471	NTIS, PC A05/MF A01
DOE/NV/10061-		
3	5:33309	NTIS, PC A02/MF A01
DOE/OR/05035-		
T1	5:33795	NTIS, PC A02/MF A01
DOE/PE/03871-		
T1	5:33775	NTIS, PC A08/MF A01
DOE/PE/70076-		
T1	5:33266	NTIS, PC A07/MF A01
DOE/PR-		
0041	5:34439	NTIS, PC A02/MF A01
DOE/RA-		
0053	5:33311	NTIS, PC A02/MF A01
DOE/RA/04934-		
05	5:33375	NTIS, PC A07/MF A01
DOE/RA/11025-		
T1(Vol.1)	5:33369	NTIS, PC A11/MF A01
T1(Vol.2)	5:33370	NTIS, PC A07/MF A01
T1(Vol.3)	5:33371	NTIS, PC A11/MF A01
T1(Vol.4)	5:33372	NTIS, PC A10/MF A01
T1(Vol.5)	5:33373	NTIS, PC A09/MF A01
T1(Vol.6)	5:33374	NTIS, PC A13/MF A01
DOE/RA/23220-		
01	5:33598	NTIS, PC A05/MF A01
DOE/RA/28320-		
1	5:33568	NTIS, PC A17/MF A01
DOE/RA/33001-		
01(Vol.1)	5:33225	NTIS, PC A23/MF A01
01(Vol.2)	5:33274	NTIS, PC A99/MF A01
DOE/SF/01424-		
26	5:33246	NTIS, PC A05/MF A01
DOE/SF/10606-		
1/1	5:33491	NTIS, PC A03/MF A01
1/2	5:33492	NTIS, PC A10/MF A01
1(App.)	5:33493	NTIS, PC A09/MF A01
DOE/SF/10608-		
1	5:33494	NTIS, PC A13/MF A01
(Exect.Summ.)	5:33495	NTIS, PC A03/MF A01
DOE/SF/10736-		
1/1	5:33496	NTIS, PC A04/MF A01
1/2	5:33497	NTIS, PC A17/MF A01
1/3	5:33498	NTIS, PC A14/MF A01
DOE/SF/10737-		
1	5:33499	NTIS PC A14/MF A01
1(Exect.Summ.)	5:33500	NTIS, PC A02/MF A01
DOE/SF/10742-		
1(Exec.Summ.)	5:33501	NTIS, PC A02/MF A01
1(Vol.1)	5:33502	NTIS, PC A08/MF A01
1(Vol.2)	5:33503	NTIS, PC A05/MF A01
DOE/TIC-		
11219	5:33316	NTIS, PC A03/MF A01
11235	5:33633	NTIS, PC A02/MF A01
11247	5:33424	NTIS, PC A02/MF A01
11249	5:34145	NTIS, PC A03/MF A01
DOE-tr-		
227	5:33838	NTIS, PC A02/MF A01
228	5:33823	NTIS, PC A02/MF A01
229	5:33824	NTIS, PC A02/MF A01
230	5:33825	NTIS, PC A02/MF A01
231	5:33826	NTIS, PC A02/MF A01
232	5:33827	NTIS, PC A02/MF A01
233	5:33828	NTIS, PC A02/MF A01
235	5:33829	NTIS, PC A02/MF A01
236	5:33837	NTIS, PC A02/MF A01
237	5:33830	NTIS, PC A02/MF A01
238	5:33831	NTIS, PC A02/MF A01
239	5:33832	NTIS, PC A02/MF A01
240	5:33833	NTIS, PC A02/MF A01
DOW/SR-		
74	5:33291	*See* FE-2346-74
DP-		
79-125-3	5:33312	NTIS, PC A03/MF A01
1525	5:34154	NTIS, PC A02/MF A01
DP-MS-		
79-73	5:33861	NTIS, PC A02/MF A01
80-17	5:33925	NTIS, PC A02/MF A01
80-37	5:34194	NTIS, PC A03/MF A01
80-47	5:33323	NTIS, PC A02/MF A01
80-73	5:33313	NTIS, PC A03/MF A01
DPSPU-		
79-30-19	5:33340	NTIS, PC A02/MF A01
DPST-		
79-146-20	5:34165	*See* GJBX-161(80)
80-146-4	5:33303	*See* GJBX-163(80)
EEB-		
80-03	5:33767	*See* LBL-10789
EEB-ENV-		
79-11	5:33779	*See* LBL-9270
EEB-Vent-		
80-8	5:33778	*See* LBL-8894(Rev.)
80-13	5:34137	*See* LBL-11097
EGG-		
1183-2369	5:34098	NTIS, PC A03/MF A01
2018	5:34420	NTIS, PC A05/MF A01
EGG-FM-		
5170	5:33570	NTIS, PC A04/MF A01
EMD-		
78-2219	5:33547	*See* NMEI-50
78-2228	5:33482	*See* NMEI-22
EML-		
380	5:34186	NTIS, PC A07/MF A01
ENICO-		
1046	5:33617	NTIS, PC A02/MF A01
EPA-		
600/1-79-044	5:34199	*See* ORNL/EIS-130
600/8-80-020	5:34118	Environmental Protection Agency, Office of Environmental Engineering and Technology, Washington, DC
EPA/600/9-		
79-019	5:34119	Environmental Protection Agency, Washington, DC
EPRI-AP-		
1510	5:33734	NTIS, PC A06/MF A01
EPRI-CS-		
1418	5:33587	NTIS, PC A09/MF A01
1444(Vol.2)	5:33590	NTIS, PC A06/MF A01
1456	5:34033	NTIS, PC A14/MF A01
1465	5:33238	NTIS, PC A09/MF A01
1469	5:34063	NTIS, PC A09/MF A01
1475	5:34064	NTIS, PC A09/MF A01
EPRI-EA-		
1148(Vol.1)	5:34195	NTIS, PC A05/MF A01
1438	5:33596	NTIS, PC A08/MF A01
1446	5:33735	NTIS, PC A10/MF A01
1471	5:33742	NTIS, PC A11/MF A01
1477	5:33706	NTIS, PC A14/MF A01
1492	5:34120	NTIS, PC A07/MF A01
1498(Vol.1)	5:34121	NTIS, PC A09/MF A01
EPRI-EL-		
1424(Vol.3)	5:33591	NTIS, PC A17/MF A01
1435	5:33603	NTIS, PC A13/MF A01
1455	5:33600	NTIS, PC A11/MF A01
1480	5:33604	NTIS, PC A05/MF A01
1484	5:33601	NTIS, PC A02/MF A01
1496	5:33609	NTIS, PC A05/MF A01
1500	5:33605	NTIS, PC A12/MF A01
EPRI-EM-		
1348(Vol.1)	5:33760	NTIS, PC A03/MF A01
EPRI-WS-		
79-163	5:34122	NTIS, PC A03/MF A01
ESL-		
31	5:33563	*See* DOE/ID/12079-1
34	5:33555	*See* DOE/ET/28392-42
35	5:33561	*See* DOE/ID/12079-3
36	5:33562	*See* DOE/ID/12079-6
FE-		
2012-096(App.)	5:33185	NTIS, PC A09/MF A01
2012-096(Sect.1)(Exec.Summ.)	5:33189	NTIS, PC A03/MF A01
2012-096(Sect.4)	5:33186	NTIS, PC A15/MF A01
2270-48	5:33201	NTIS, PC A07/MF A01
2346-74	5:33291	NTIS, PC A02/MF A01
2471-45	5:34065	NTIS, PC A04/MF A01
2496-42	5:33220	NTIS, PC A06/MF A01
3125-21	5:33187	NTIS, PC A08/MF A01
FERC/EIS-		
0009	5:33284	NTIS, PC A19/MF A01
FERMILAB-CONF-		
80/56-EXP	5:34273	NTIS, PC A02/MF A01
80/57-EXP	5:34281	NTIS, PC A02/MF A01
80/63-THY	5:34289	NTIS, PC A02/MF A01
80/66-THY	5:34290	NTIS, PC A02/MF A01
80/68-THY	5:34301	NTIS, PC A02/MF A01
80/69	5:34302	NTIS, PC A02/MF A01
FMI-		
45	5:34174	NTIS, PC A04/MF A01

Report No.	Abstract No.	Availability
FR-		
13019	5:33795	*See* DOE/OR/05035-T1
FRCR-		
212	5:34401	*See* DOE/ET/53036-17
GA-A-		
15825	5:33886	NTIS, PC A02/MF A01
15932	5:33618	NTIS, PC A03/MF A01
15935	5:33354	NTIS, PC A03/MF A01
15942	5:33613	NTIS, PC A02/MF A01
15963	5:34399	NTIS, PC A02/MF A01
GEFR-SP-		
205	5:33862	NTIS, PC A03/MF A01
GJBX-		
124(80)	5:33301	NTIS, PC E01/MF, $3.50
160(80)	5:33302	NTIS, PC E11/MF, $12.20
161(80)	5:34165	NTIS, PC A05/MF A01
163(80)	5:33303	NTIS, PC E03/MF, $3.50
164(80)	5:33304	NTIS, PC E06/MF, $3.50
HEDL-SA-		
2019-FP	5:34436	NTIS, PC A03/MF A01
2041	5:34088	NTIS, PC A02/MF A01
2112-FD	5:33619	NTIS, PC A02/MF A01
2123-FP	5:34082	NTIS, PC A02/MF A01
2138	5:33310	NTIS, PC A02/MF A01
2189	5:33852	NTIS, PC A02/MF A01
HEDL-TME-		
79-78	5:33620	NTIS, PC A04/MF A01
HIT-		
706	5:33713	*See* P-300-80-007
706-2	5:33714	*See* P-300-80-008
706-3	5:33715	*See* P-300-80-009
706-4	5:33716	*See* P-300-80-010
706-4	5:33717	*See* P-300-80-011
706-5	5:33718	*See* P-300-80-012
706-6	5:33719	*See* P-300-80-013
706-7	5:33720	*See* P-300-80-014
706-8	5:33721	*See* P-300-80-015
706-10	5:33723	*See* P-300-80-017
706-12	5:33724	*See* P-300-80-018
HNEI-		
80-04	5:33699	Univ. of Hawaii, Hawaii Natural Energy Inst., Manoa
HUD-PDR-		
481	5:33472	NTIS, PC A07/MF A01
IAEA-CN-		
38/PD	5:34399	*See* GA-A-15963
IFSM-		
80-104	5:33188	NTIS, PC A04/MF A01
IS-		
4709	5:34123	NTIS, PC A03/MF A01
4723	5:33404	NTIS, PC A05/MF A01
4737	5:34369	NTIS, PC A03/MF A01
4744	5:33221	NTIS, PC A03/MF A01
4747	5:33887	NTIS, PC A12/MF A01
IS-M-		
285	5:34124	NTIS, PC A03/MF A01
286	5:33473	NTIS, PC A02/MF A01
289	5:33222	NTIS, PC A02/MF A01
290	5:33474	NTIS, PC A02/MF A01
IS-T-		
899	5:33866	NTIS, PC A06/MF A01
900	5:34045	NTIS, PC A06/MF A01
909	5:33934	NTIS, PC A06/MF A01
910	5:33927	NTIS, PC A08/MF A01
923	5:33215	NTIS, PC A06/MF A01
924	5:33223	NTIS, PC A06/MF A01
925	5:33867	NTIS, PC A06/MF A01
928	5:33948	NTIS, PC A04/MF A01
IWGFR-		
29	5:33621	NTIS, PC A11/MF A01
JAPFNR-		
502	5:33622	NTIS (US Sales Only), PC A02/MF A01
503	5:33623	NTIS (US Sales Only), PC A02/MF A01
506	5:33624	NTIS (US Sales Only), PC A02/MF A01
507	5:33625	NTIS (US Sales Only), PC A03/MF A01
508	5:33630	NTIS (US Sales Only), PC A02/MF A01
509	5:33614	NTIS (US Sales Only), PC A02/MF A01
JHU/APL-GEM-		
007	5:33776	NTIS, PC A03/MF A01

Report No.	Abstract No.	Availability
JPL-		
9950-374	5:33835	*See* DOE/JPL/955283-1
JPL-PUB-		
79-8(Vol.1)	5:33539	*See* DOE/JPL-1060-12(Vol.1)
79-8(Vol.2)	5:33447	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33448	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33449	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33450	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33451	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33455	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33456	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33540	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33541	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33542	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33543	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33544	*See* DOE/JPL-1060-12(Vol.2)
79-8(Vol.2)	5:33642	*See* DOE/JPL-1060-12(Vol.2)
79-118(Vol.2)	5:33452	*See* DOE/JPL-1060-31(Vol.2)
80-48(Vol.2)	5:33740	NTIS, PC A12/MF A01
JPL-PUBL-		
80-48(Vol.1)	5:33606	NTIS, PC A04/MF A01
80-48(Vol.2)	5:33607	NTIS, PC A12/MF A01
JPRS-		
75887	5:33242	NTIS
75887	5:33271	NTIS
75887	5:33557	NTIS
75887	5:33558	NTIS
Juel-Spez-		
57	5:33761	NTIS (US Sales Only), PC A05/MF A01
64	5:33777	NTIS (US Sales Only), PC A05/MF A01
K/OA-		
4748	5:33347	NTIS, PC A03/MF A01
K/UR-		
34	5:33304	*See* GJBX-164(80)
LA-		
7689-M(Ver.2.1)	5:33762	NTIS, PC A99/MF A01
8095	5:34443	NTIS, PC A06/MF A01
8179-MS	5:34313	NTIS, PC A02/MF A01
8257-PR	5:34066	NTIS, PC A06/MF A01
8297-PR	5:33324	NTIS, PC A03/MF A01
8313-M	5:33342	NTIS, PC A04/MF A01
8368-MS	5:33280	NTIS, PC A03/MF A01
8394-MS	5:34346	NTIS, PC A02/MF A01
8405-MS	5:34072	NTIS, PC A02/MF A01
8407-PR	5:34250	NTIS, PC A04/MF A01
8440-MS	5:33300	NTIS, PC A02/MF A01
8442-MS	5:34073	NTIS, PC A02/MF A01
8444-MS	5:34067	NTIS, PC A02/MF A01
8446-PR	5:34379	NTIS, PC A02/MF A01
8454-PR	5:33349	NTIS, PC A03/MF A01
8458-MS	5:34421	NTIS, PC A02/MF A01
8469-MS	5:34422	NTIS, PC A02/MF A01
8473-MS	5:34229	NTIS, PC A02/MF A01
8497-MS	5:33267	NTIS, PC A03/MF A01
LA-UR-		
79-3016	5:34225	NTIS, PC A02/MF A01
80-1185	5:34444	NTIS, PC A02/MF A01
80-1617	5:34021	NTIS, PC A02/MF A01
80-1669	5:33475	NTIS, PC A02/MF A01
80-1753	5:34141	NTIS, PC A03/MF A01
80-1855	5:34074	NTIS, PC A02/MF A01
80-1856	5:34083	NTIS, PC A02/MF A01
80-1905	5:34076	NTIS, PC A02/MF A01
80-1919	5:34312	NTIS, PC A02/MF A01
80-1925	5:34325	NTIS, PC A02/MF A01
80-1933	5:34366	NTIS, PC A02/MF A01
80-1943	5:34095	NTIS, PC A02/MF A01
80-1945	5:34078	NTIS, PC A02/MF A01
80-1946	5:34086	NTIS, PC A02/MF A01
80-1976	5:34274	NTIS, PC A02/MF A01
80-1977	5:34328	NTIS, PC A02/MF A01
80-2039	5:34046	NTIS, PC A02/MF A01
80-2040	5:34047	NTIS, PC A02/MF A01
80-2043	5:34402	NTIS, PC A02/MF A01
80-2182	5:34370	NTIS, PC A02/MF A01
80-2197	5:34233	NTIS, PC A02/MF A01
80-2231	5:33476	NTIS, PC A02/MF A01
80-2235	5:34293	NTIS, PC A02/MF A01
80-2236	5:33477	NTIS, PC A02/MF A01
80-2266	5:33478	NTIS, PC A02/MF A01
80-2268	5:33479	NTIS, PC A02/MF A01
80-2328	5:33480	NTIS, PC A02/MF A01
80-2329	5:33519	NTIS, PC A02/MF A01
80-2330	5:33481	NTIS, PC A02/MF A01

Report No.	Abstract No.	Availability
80-2342	5:34445	NTIS, PC A02/MF A01
80-2343	5:34446	NTIS, PC A02/MF A01
80-2354	5:33736	NTIS, PC A02/MF A01
80-2371	5:34275	NTIS, PC A02/MF A01
80-2372	5:34371	NTIS, PC A02/MF A01
80-2373	5:34251	NTIS, PC A02/MF A01
80-2374	5:34252	NTIS, PC A02/MF A01
80-2375	5:34253	NTIS, PC A02/MF A01
80-2376	5:34254	NTIS, PC A02/MF A01
80-2377	5:34255	NTIS, PC A02/MF A01
80-2400	5:33355	NTIS, PC A02/MF A01
80-2406	5:34414	NTIS, PC A02/MF A01
80-2414	5:33928	NTIS, PC A02/MF A01
80-2427	5:34319	NTIS, PC A02/MF A01
80-2429	5:33545	NTIS, PC A02/MF A01
80-2496	5:34354	NTIS, PC A04/MF A01
80-2499	5:34423	NTIS, PC A02/MF A01
80-2500	5:34415	NTIS, PC A02/MF A01
LBL-		
8678(Rev.1)	5:33763	NTIS, PC A99/MF A01
8688(Rev.1)	5:33764	NTIS, PC A05/MF A01
8706(Rev.1)	5:33762	*See* LA-7689-M(Ver.2.1)
8894(Rev.)	5:33778	NTIS, PC A03/MF A01
8957	5:34234	NTIS, PC A23/MF A01
8957	5:34282	NTIS, PC A23/MF A01
8957	5:34283	NTIS, PC A23/MF A01
8957	5:34303	NTIS, PC A23/MF A01
8957	5:34320	NTIS, PC A23/MF A01
8957	5:34321	NTIS, PC A23/MF A01
8957	5:34342	NTIS, PC A23/MF A01
8957	5:34355	NTIS, PC A23/MF A01
8957	5:34356	NTIS, PC A23/MF A01
8957	5:34357	NTIS, PC A23/MF A01
8957	5:34358	NTIS, PC A23/MF A01
8957	5:34359	NTIS, PC A23/MF A01
8957	5:34363	NTIS, PC A23/MF A01
9062	5:33296	NTIS, PC A20/MF A01
9270	5:33779	NTIS, PC A04/MF A01
9803	5:33765	NTIS, PC A02/MF A01
9821	5:33766	NTIS, PC A02/MF A01
9892	5:34177	NTIS, PC A03/MF A01
9941	5:33853	NTIS, PC A07/MF A01
10189/1	5:34447	NTIS, PC A03/MF A01
10437	5:34458	NTIS, PC A02/MF A01
10540	5:33554	NTIS, PC A02/MF A01
10541	5:33325	NTIS, PC A04/MF A01
10648	5:34459	NTIS, PC A02/MF A01
10651	5:33914	NTIS, PC A04/MF A01
10705	5:33780	NTIS, PC A03/MF A01
10761	5:34380	NTIS, PC A03/MF A01
10789	5:33767	NTIS, PC A02/MF A01
10952	5:33868	NTIS, PC A06/MF A01
10994	5:33854	NTIS, PC A05/MF A01
10995	5:33869	NTIS, PC A04/MF A01
11017	5:34099	NTIS, PC A09/MF A01
11055	5:34381	NTIS, PC A02/MF A01
11072	5:33299	NTIS, PC A02/MF A01
11086	5:33247	NTIS, PC A02/MF A01
11097	5:34137	NTIS, PC A03/MF A01
11107	5:33569	NTIS, PC A02/MF A01
11123	5:34360	NTIS, PC A03/MF A01
11141	5:34416	NTIS, PC A02/MF A01
11178	5:34220	NTIS, PC A02/MF A01
11183	5:33666	NTIS, PC A05/MF A01
11192	5:34138	NTIS, PC A02/MF A01
11202	5:33888	NTIS, PC A03/MF A01
11237	5:34125	NTIS, PC A03/MF A01
11349	5:33673	NTIS, PC A04/MF A01
11350	5:33674	NTIS, PC A03/MF A01
LMF-		
75	5:34198	NTIS, PC A03/MF A01
MCR-		
80-1352	5:33500	*See* DOE/SF/10737-1(Exect.Summ.)
80-1353	5:33499	*See* DOE/SF/10737-1
MLM-		
2727	5:33939	NTIS, PC A04/MF A01
2758	5:34139	NTIS, PC A02/MF A01
2762(OP)	5:34102	NTIS, PC A02/MF A01
MLM-EGSP-TPR-Q-		
014	5:33289	*See* MLM-MU-80-68-0002
MLM-MU-		
80-68-0002	5:33289	NTIS, PC A13/MF A01
NASA-CR-		
159854	5:33821	*See* DOE/NASA/0008-80/11
165135	5:33756	*See* DOE/NASA/0150-80/4
NASA-TM-		
81551	5:33839	*See* DOE/NASA/1040-16
81555	5:33747	*See* DOE/NASA/1062-6
NBL-		
296	5:33308	NTIS, PC A02/MF A01
NBS-BSS-		
113	5:33785	NTIS, PC A05/MF A01
114	5:33768	NTIS, PC A04/MF A01
117	5:33520	NTIS, PC A07/MF A01
NBS-TN-		
982	5:33781	NTIS, PC A04/MF A01
NCEI-		
0017	5:33816	NTIS, PC A04/MF A01
NLM/TIRC-		
80/2	5:34126	NTIS, PC A04/MF A01
NMEI-		
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NP-		
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22587	5:33726	EPRI, Palo Alto, CA
22588	5:33727	EPRI, Palo Alto, CA
22589	5:33728	EPRI, Palo Alto, CA
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25010	5:33425	NTIS (US Sales Only), PC A03/MF A01
25011	5:33426	NTIS (US Sales Only), PC A02/MF A01
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25047	5:33792	NTIS (US Sales Only), PC A02/MF A01
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NRL-MR-		
4180	5:34424	NTIS, PC A02/MF A01
ONWI-		
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ORAU-		
168	5:33232	NTIS, PC A04/MF A01
170	5:33817	NTIS, PC A03/MF A01
ORESU-W-		
78-001	5:33548	Oregon State Univ., Sea Grant College Program, Corvallis
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78-001	5:33579	Oregon State Univ., Sea Grant College Program, Corvallis
78-001	5:33580	Oregon State Univ., Sea Grant College Program, Corvallis
ORNL-		
5465	5:34151	NTIS, PC A04/MF A01
ORNL/CSD-		
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ORNL/CSD/TM-		
68	5:34190	NTIS, PC A02/MF A01
ORNL/EIS-		
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ORNL/HUD/MIUS-		
53	5:33813	NTIS, PC A04/MF A01
ORNL/Sub-		
79/13617/2	5:33326	NTIS, PC A99/MF A01
7470/1-V3	5:33769	NTIS, PC A18/MF A01
ORNL/TM-		
7049	5:34413	NTIS, PC A09/MF A01
7127	5:34158	NTIS, PC A10/MF A01
7186	5:33679	NTIS, PC A03/MF A01
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7405	5:34238	NTIS, PC A06/MF A01
7407	5:34403	NTIS, PC A03/MF A01
7417	5:34128	NTIS, PC A02/MF A01
7422	5:34417	NTIS, PC A04/MF A01
ORO-		
778	5:33314	NTIS, PC A05/MF A01
OTA-E-		
92(Vol.1)	5:33782	GPO
124	5:33429	GPO
OTA-TM-E-		
1	5:33430	GPO
P-		
102-80-004	5:33712	California Energy Commission, Sacramento
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300-80-012	5:33718	California Energy Commission, Sacramento
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4,166,786	5:33180	
4,166,787	5:33272	
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4,166,886	5:33649	
4,167,607	5:33662	
4,168,349	5:33648	
4,168,350	5:33661	
4,168,772	5:33646	
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4,169,191	5:33836	
4,169,192	5:33660	
4,169,223	5:33647	

Report No.	Abstract No.	Availability
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4,174,565	5:33644	
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4,175,725	5:33653	
4,176,021	5:33654	
4,177,120	5:33178	
4,178,228	5:33261	
4,178,230	5:33262	
4,178,950	5:33276	
4,178,951	5:33275	
4,178,967	5:34025	
4,179,354	5:33253	
4,179,356	5:33251	
4,179,357	5:33252	
4,179,358	5:33260	
4,179,359	5:33259	
4,179,360	5:33258	
4,179,361	5:33257	
4,179,362	5:33256	
4,179,409	5:33255	
4,179,410	5:33254	
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4,180,770	5:33652	
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PB-		
80-126956	5:33700	NTIS$13.00
PCTR-		
92-80	5:33701	NTIS, PC A06/MF A01
PEP-NOTE-		
331	5:34390	*See* SLAC-PUB-2547
333	5:34075	*See* SLAC-PUB-2548
PNL-		
2579	5:33930	NTIS, PC A02/MF A01
2882	5:34223	NTIS, PC A03/MF A01
3290	5:33317	NTIS, PC A05/MF A01
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3399	5:33635	NTIS, PC A04/MF A01
3426	5:33584	NTIS, PC A03/MF A01
3458	5:33592	NTIS, PC A06/MF A01
3468	5:33233	NTIS, PC A02/MF A01
PNL-SA-		
7417	5:34257	NTIS, PC A02/MF A01
7422	5:33589	NTIS, PC A02/MF A01
7658	5:34129	NTIS, PC A02/MF A01
7778	5:33405	NTIS, PC A03/MF A01
8014	5:33318	NTIS, PC A02/MF A01
8017	5:33627	NTIS, PC A02/MF A01
8106	5:34187	NTIS, PC A02/MF A01
8110	5:34188	NTIS, PC A02/MF A01
8170	5:34130	NTIS, PC A03/MF A01
8202	5:34218	NTIS, PC A02/MF A01
8291	5:34192	NTIS, PC A02/MF A01
8295	5:33863	NTIS, PC A02/MF A01
8414	5:33319	NTIS, PC A02/MF A01
8431	5:34131	NTIS, PC A03/MF A01
PPPL-		
1683	5:34236	NTIS, PC A03/MF A01
1688	5:34398	NTIS, PC A02/MF A01
1692	5:34395	NTIS, PC A02/MF A01
PUB-		
367	5:34440	NTIS, PC A99/MF A01
RAND/N-		
1469-DOE	5:33708	NTIS, PC A03/MF A01
RFP-		
2945	5:33320	NTIS, PC A02/MF A01
3110	5:33328	NTIS, PC A03/MF A01
RFP-Trans-		
285	5:33883	NTIS, PC A02/MF A01
RHO-BWI-CD-		
35	5:33329	NTIS, PC A99/MF A01
RHO-SA-		
174	5:33321	NTIS, PC A02/MF A01
SAI/OR-		
565-2	5:33326	*See* ORNL/Sub-79/13617/2
SAN-		
11276-4	5:33754	NTIS, PC A18/MF A01
SAND-		
78-1065	5:34055	NTIS, PC A05/MF A01
79-0284	5:33330	NTIS, PC A05/MF A01
79-0377	5:33331	NTIS, PC A03/MF A01
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79-1110	5:33332	NTIS, PC A04/MF A01
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79-1490	5:34057	NTIS, PC A03/MF A01
79-1540C	5:34372	NTIS, PC A02/MF A01
80-0085	5:33585	NTIS, PC A04/MF A01
80-0261	5:34032	NTIS, PC A03/MF A01
80-0312C	5:33334	NTIS, PC A02/MF A01
80-0420C	5:34058	NTIS, PC A02/MF A01
80-0444C	5:33565	NTIS, PC A02/MF A01
80-0481	5:33949	NTIS, PC A09/MF A01
80-0697	5:33950	NTIS, PC A03/MF A01
80-0777	5:33292	NTIS, PC A02/MF A01
80-1019	5:33248	NTIS, PC A02/MF A01
80-1038C	5:33870	NTIS, PC A02/MF A01
80-1124	5:34448	NTIS, PC A02/MF A01
80-1146	5:34449	NTIS, PC A03/MF A01
80-1157	5:34103	NTIS, PC A05/MF A01
80-1252C	5:34460	NTIS, PC A03/MF A01
80-1292	5:33249	NTIS, PC A04/MF A01
80-1315C	5:33951	NTIS, PC A02/MF A01
80-1380C	5:33952	NTIS, PC A02/MF A01
80-1388C	5:34084	NTIS, PC A03/MF A01
80-1428C	5:33612	NTIS, PC A03/MF A01
80-1482	5:33953	NTIS, PC A02/MF A01
80-1533C	5:33335	NTIS, PC A02/MF A01
80-1534	5:33954	NTIS, PC A03/MF A01
80-1546	5:34426	NTIS, PC A03/MF A01
80-1585	5:33571	NTIS, PC A02/MF A01
80-1606C	5:33336	NTIS, PC A02/MF A01
80-1642	5:33931	NTIS, PC A03/MF A01
80-1697C	5:34373	NTIS, PC A02/MF A01
80-1838C	5:33915	NTIS, PC A03/MF A01
80-1871C	5:33675	NTIS, PC A03/MF A01
80-1873C	5:33293	NTIS, PC A02/MF A01
80-1877C	5:33955	NTIS, PC A02/MF A01
80-6016	5:33958	NTIS, PC A02/MF A01
80-6016	5:33958	NTIS, PC A02/MF A01
80-6017	5:33959	NTIS, PC A02/MF A01
80-6017	5:33959	NTIS, PC A02/MF A01
80-7019	5:33638	NTIS, PC A03/MF A01
80-7097	5:33348	NTIS, PC A08/MF A01
80-7101	5:33572	NTIS, PC A03/MF A01
80-7102	5:33573	NTIS, PC A03/MF A01
80-7107	5:33339	NTIS, PC E02/MF, $3.50
80-8216	5:34104	NTIS, PC E02/MF, $3.50
80-8222	5:34100	NTIS, PC A02/MF A01
80-8733	5:34048	NTIS, PC A03/MF A01
SERI/PR-		
0-8274-3	5:33406	NTIS, PC A03/MF A01
0-8276-3	5:33407	NTIS, PC A04/MF A01
611-737	5:33408	NTIS, PC A06/MF A01
8119-2-T1	5:33409	NTIS, PC A03/MF A01
8119-2-T2	5:33410	NTIS, PC A03/MF A01
8278-1-T3	5:33411	NTIS, PC A03/MF A01
9192-1-T1	5:33412	NTIS, PC A03/MF A01
SERI/RR-		
431-328	5:33484	NTIS, PC A03/MF A01
632-702	5:33504	NTIS, PC A04/MF A01
722-329R	5:33390	NTIS, PC A04/MF A01
731-364	5:33546	NTIS, PC A11/MF A01
SERI/SP-		
763-717	5:33377	NTIS, PC A05/MF A01
98156-1	5:33391	NTIS, PC A09/MF A01
SERI/TP-		
611-407	5:33446	NTIS, PC A04/MF A01
744-661	5:33744	NTIS, PC A06/MF A01
SERI/TR-		
334-601	5:33521	NTIS, PC A03/MF A01
733-394	5:33392	NTIS, PC A03/MF A01
8157-1-T1	5:33431	NTIS, PC A12/MF A01
SLAC-PUB-		
2480	5:34059	NTIS, PC A02/MF A01
2503	5:34288	NTIS, PC A02/MF A01
2505	5:34294	NTIS, PC A02/MF A01
2510	5:34291	NTIS, PC A02/MF A01
2517	5:34279	NTIS, PC A02/MF A01
2519	5:34276	NTIS, PC A02/MF A01
2526	5:34085	NTIS, PC A02/MF A01
2532	5:34280	NTIS, PC A03/MF A01
2547	5:34390	NTIS, PC A02/MF A01
2548	5:34075	NTIS, PC A03/MF A01
SLAC-TN-		
80-2	5:34450	NTIS, PC A04/MF A01

SOLAR/1001-		
80/50	5:33485	NTIS, PC A03/MF A01
SOLAR/1012-		
80/50	5:33486	NTIS, PC A04/MF A01
SOLAR/1024-		
80/50	5:33487	NTIS, PC A04/MF A01
SOLAR/1029-		
80/50	5:33488	NTIS, PC A04/MF A01
TAC-HP-		
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TAC-STC-		
79-004	5:33460	Technology Application Center, Univ. of New Mexico, Albuquerque
TAC-STHC-		
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TE-		
4257-72-80	5:33819	NTIS, PC A03/MF A01
4257-207-80	5:33820	NTIS, PC A04/MF A01
TR-EE-		
80-18	5:33701	*See* PCTR-92-80
UCB/ERG-		
80-1	5:33680	NTIS, PC A06/MF A01
UCID-		
18577	5:34309	NTIS, PC A02/MF A01
18577	5:34314	NTIS, PC A02/MF A01
18577	5:34329	NTIS, PC A02/MF A01
18577	5:34331	NTIS, PC A02/MF A01
18577	5:34335	NTIS, PC A02/MF A01
18577	5:34347	NTIS, PC A02/MF A01
18577	5:34348	NTIS, PC A02/MF A01
18577	5:34349	NTIS, PC A02/MF A01
18672	5:33626	NTIS, PC A02/MF A01
18764	5:33522	NTIS, PC A03/MF A01
18766	5:33923	NTIS, PC A02/MF A01
18771	5:34132	NTIS, PC A02/MF A01
UCLA-		
12-1257	5:34175	NTIS, PC A02/MF A01
12-1258	5:34176	NTIS, PC A02/MF A01
12-1261	5:34178	NTIS, PC A02/MF A01
UCRL-		
15137	5:34022	NTIS, PC A05/MF A01
15258	5:34451	NTIS, PC A02/MF A01
52749	5:33337	NTIS, PC A04/MF A01
52868	5:34427	NTIS, PC A05/MF A01
52921	5:34105	NTIS, PC A02/MF A01
52956	5:34221	NTIS, PC A06/MF A01
52966	5:34153	NTIS, PC A03/MF A01
52969	5:34222	NTIS, PC A02/MF A01
52975	5:34049	NTIS, PC A16/MF A01
81944	5:33634	NTIS, PC A02/MF A01
83398	5:33343	NTIS, PC A02/MF A01
83399	5:33344	NTIS, PC A02/MF A01
83559	5:33957	NTIS, PC A02/MF A01
83783	5:33911	NTIS, PC A02/MF A01
83875	5:33909	NTIS, PC A02/MF A01
84136	5:33432	NTIS, PC A02/MF A01
84259(Rev.1)	5:34365	NITS, PC A02/MF A01
84318	5:34023	NTIS, PC A02/MF A01
84339	5:34133	NTIS, PC A02/MF A01
84440	5:33871	NTIS, PC A02/MF A01
84446	5:34452	NTIS, PC A02/MF A01
84456	5.34437	NTIS, PC A02/MF A01
84489	5:33575	NTIS, PC A02/MF A01
84587	5:34106	NTIS, PC A02/MF A01
84613	5:33338	NTIS, PC A02/MF A01
84655	5:34034	NTIS, PC A03/MF A01
84677	5:34134	NTIS, PC A02/MF A01
84839	5:33681	NTIS, PC A02/MF A01
UPR-		
75E	5:34094	*See* COO-3071-245
UR-		
3490-1878	5:34183	NTIS, PC A05/MF A01
USGS-OFR-		
80-611	5:34224	NTIS, PC A06/MF A01
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Y/DX-		
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☆ U.S. GOVERNMENT PRINTING OFFICE: 1980—740-143/22

Abbreviations Used in Availability Column

AT Liquid Metal Fast Breeder Reactor applied technology is available to domestic requesters within the United States from the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.
Information regarding subscription purchase will be sent on request.
Foreign requesters should address inquiries to the above address.

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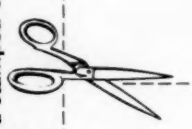

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